SCIENTIFIC AMERICAN

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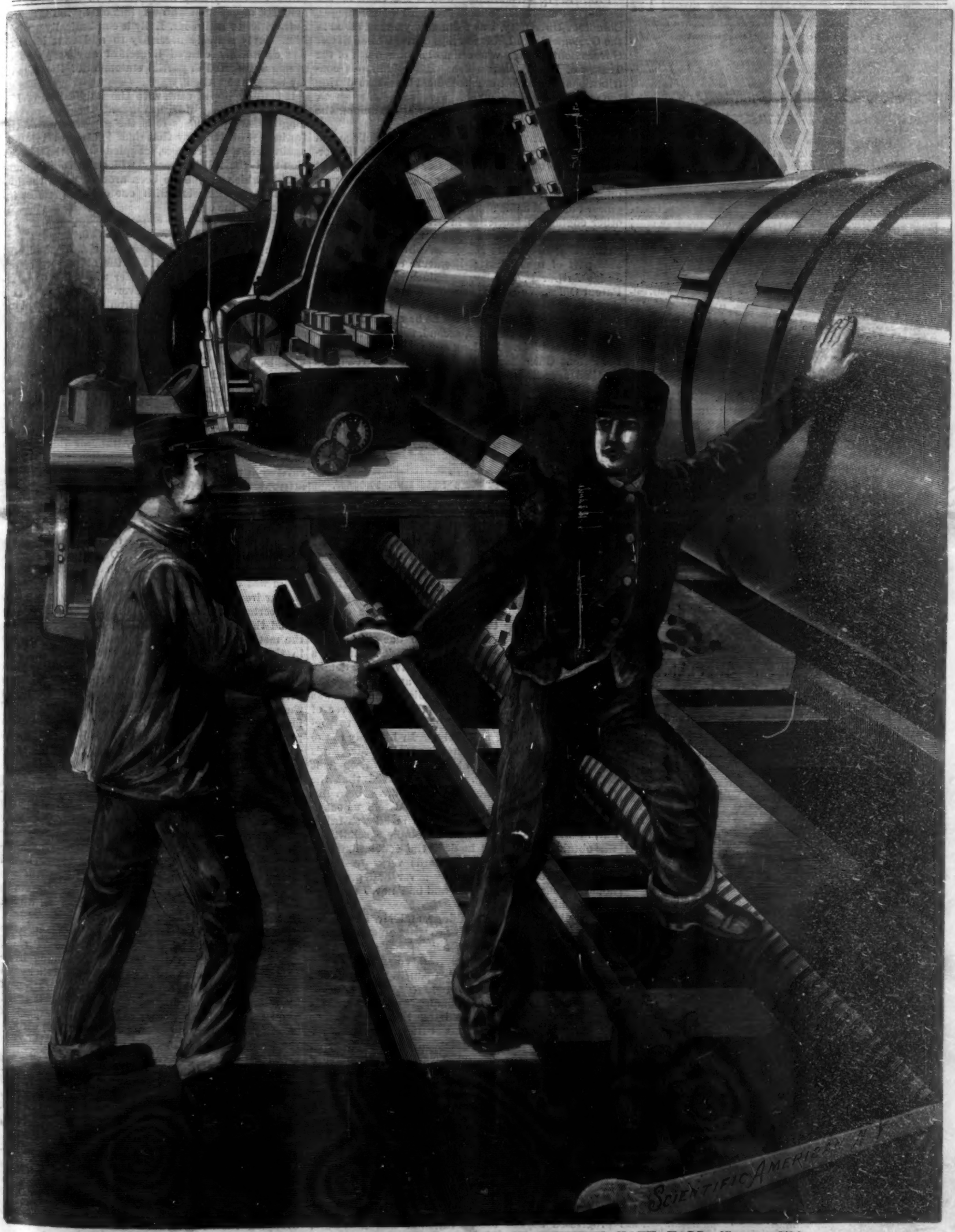

THE GREAT SIXTEEN INCH GUN LATHE AT THE WASHINGTON NAVY YARD.—[See page 343.]

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OUR PRIZE ESSAY COMPETITION.

We take much pleasure in announcing that Judge A. P. Greeley, of the Patent Office, Washington, Prof. R. H. Thurston, of Cornell University, and Prof. R. S. Woodward, of Columbia University, have consented to act as judges in our forthcoming prize essay competition. Their names are so well and honorably known in the world of science and art as to need no introduction to our readers, and intending competitors will feel that the wide experience and ripe attainments of these gentlemen are a guarantee that their interests will be in safe and discriminating hands.

Prof. R. S. Woodward, who is the Dean of the School of Pure Science and Professor of Mechanics, Columbia University, was for many years engaged in the Geological and Lake Surveys of the United States Government, during which time he formed one of the Transit of Venus Commission. His voluminous contributions to scientific and technical literature during the past twenty years cover a wide range of subjects, and have won for him a high reputation among the scientific societies of both hemispheres.

Prof. R. H. Thurston, Director of Sibley College and Professor of Mechanical Engineering, Cornell University, was for many years Professor of Engineering at the Stevens Institute of Technology. He is a past president of the American Society of Mechanical Engineers, and his name appears upon the roll of many other engineering societies in Europe and America. Perhaps he is best known by his many works upon engineering and kindred subjects, which form a valuable part of the technical literature of this country. Judge Arthur P. Greeley, Examiner in Chief at the Patent Office, Washington, who is a lawyer by profession, has won his present high position in various competitive examinations, in which he has gained successively the position of third, second, first assistant and principal examiner. His long and varied experience in the Patent Office has given him at once a broad and detailed acquaintance with the development of the various arts in the past half century.

With the selection of a jury, the arrangements for the competition are now complete, and we trust that intending competitors will facilitate the work of these gentlemen by forwarding their manuscripts at the earliest convenient date.

THE INVENTION OF THE BESSEMER PROCESS.

Some further correspondence relating to the invention of the Bessemer process has lately appeared in the technical press, and as it comes from the pen of Mr. Bessemer himself and of one of the contemporaries and co-workers of Mr. Kelly, it is of special interest. By reference to the presidential address of Mr. Joseph D. Weeks before the American Institute of Mining Engineers, published in the SUPPLEMENT of April 25, it will be seen that among other witnesses quoted therein as testifying to having seen Mr. Kelly's experiments is Mr. John E. Fry, who was at the time a foundry moulder at the Cambria Works. Mr. Fry's testimony, as quoted by Mr. Weeks, gives some details of the apparatus used by Mr. Kelly, and describes the experiments up to the point at which "the pipe was shoved down with the blast on," and "a cover of pieces of sheet iron was laid across the top to prevent the sparks flying too freely." In his reply to the address, Mr. Bessemer complained that Mr. Fry's testimony stopped short at the very point where it became most interesting, and he claimed that the testimony of the witnesses "would have been infinitely more to the purpose if they had told us something about the way in which this metal was taken out, in what state of partial or complete solidity it was obtained," etc., and he drew the conclusion that "the absence of these facts affords very strong circumstantial evidence that Kelly never had produced homogeneous malleable iron, and had never made an ingot by his process."

The publication of the address, and Mr. Bessemer's reply, caused Mr. John E. Fry to write an explanatory letter to Mr. Bessemer, which has been widely published in the English technical press. The letter, with Mr. Bessemer's comments upon it, will be found in the current issue of the SUPPLEMENT.

Mr. Fry, who is now the manager of the Cambria Steel Works, states in this letter that the evidence which was quoted in the presidential address was extracted from some "personal recollections" which he furnished to Mr. Weeks in the course of a two hours' conversation on the subject of the early Kelly experiments, a conversation which took place at Mr. Weeks' request. In connection with this interview, he furnished Mr. Weeks with a drawing of Mr. Kelly's apparatus made in 1858, and also with a copy of an article which he had written in 1894, entitled "The Bessemer Industry: Johnstown's Contribution to it." He goes on to say: "My interview with Mr. Weeks gave him vivid personal recollections antagonistic to his views. The drawing proved that, as late as the year 1858, Mr. Kelly's experiments and ideas had not progressed beyond the operation of the 'finery fire,' and the printed article gave what I believe to be the very first public announcement of Mr. Kelly's absolute failure to accomplish anything that would give ground to his claim of being the inventor of the pneumatic process of converting cast iron into its malleable products." He further says of the Johnstown publication above referred to, "In it I made as plain as circumstances would warrant that Mr. Kelly was copying your methods as fully as his limited sources of information enabled him to do, and that he was doing only that."

The publication of this very timely letter can have but one effect as far as the evidence in favor of Mr. Kelly's claims is concerned. It shows that whatever other testimony may be adduced in his favor, the evidence of the man who was told off by the Cambria authorities to assist Mr. Kelly is emphatically against him. It is scarcely necessary to add that Mr. Fry has completely cleared himself of any suspicion of giving a distorted or partial statement of the facts as far as he knew them.

It is to be hoped that, with the publication of Mr. Fry's letter, the public has heard the last of this long-buried question. It is the great value of the testimony of Mr. Fry that has led us to bring it again before our readers, coupled with the conviction that the full testimony will serve to settle any doubts which may have been aroused as to the historical facts connected with one of the greatest inventions of the century.

MOLECULAR ANNEALING.

Thanks to the investigations of Mr. Alexander E. Outerbridge, Jr., the ghost of the old theory of the crystallization of cast iron under the influence of repeated shocks is "laid" forever. According to this gentleman, not only is cast iron not weakened by repeated blows, but it is actually and considerably strengthened thereby. Mr. Outerbridge, who is now chemist to the William Sellers Company, of Philadelphia, noticed some years ago, when he was engaged in metallurgical work in a car wheel factory, that "chilled cast iron car wheels rarely cracked in ordinary service after having been used for any considerable time; if wheels did not crack when comparatively new, they usually lasted until worn out or condemned for other causes." Although this curious fact was noticed, its real explanation was not discovered at the time, the cracking of new wheels being attributed to imperfect annealing in the oven.

In 1894 Mr. Outerbridge had occasion to test some cast iron bars for the Sellers Company. Before testing they were placed in a tumbling barrel to be cleaned, and when they came to be broken in the transverse testing machine Mr. Outerbridge "noticed with surprise that the average strength of the entire series was considerably higher than was usual with similar iron mixtures." A careful inquiry was made to ascertain the cause of the difference; but it was found that the machine was in good order and that the metal was of normal composition. The next step in the investigation was to cast twelve bars from one pattern and one runner. Six of these were cleaned by the tumbler and six with a wire brush. Upon breaking the twelve bars in the machine, it was found that those which had been subjected to four hours' incessant concussion in the tumbler were ten to fifteen per cent stronger than the other bars! Various explanations were offered and proved by experiment to be false, until Mr. Outerbridge suggested that the increase of strength might be due to the "mobility of molecules of cast iron at ordinary temperature when subjected to repeated shocks." This theory was tested by subjecting each of six new cast iron bars to 3,000 taps with a hammer upon one end. When they were broken in the machine they showed the same increase of strength as the bars that had been cleaned in the tumbler. He reasonably concluded that he had proved his case, and the engineering world is certainly indebted to him for the discovery of a most remarkable property of cast iron.

The details of Mr. Outerbridge's experiments were given in a paper which he read before the Pittsburg meeting of the American Institute of Mining Engineers. He claims that while it is very well known that the annealing of castings increases their strength by releasing the strains set up in cooling, it is not known that "the molecules of cast iron are capable of movement (for they do not touch each other) without the necessity of heating the castings, and they can thus rearrange themselves in comfortable relation to their neighbors and relieve the overcrowding near the surface of the casting; or, in more technical words, a molecular annealing may be accomplished at ordinary temperatures which will release the strains in the castings, precisely as does annealing by slow cooling in heated pits or ovens."

In addition to the transverse tests already enumerated, a series of impact experiments by means of a falling weight were carried out.

"Six of the 1 inch square test bars, cleaned with the wire brush, were broken upon the impact machine by dropping the weight from a sufficient height to break each bar at the first blow; the six companion bars, also cleaned with the brush, were then in turn sub-

jected to blows numbering from ten to fifty each of the same drop weight, falling one-half the former distance, these blows being insufficient to break the bars. The weight was then permitted to fall upon each of these bars in turn, from the height at which the six bars previously tested were broken on first blow. Not one bar broke. Two, three, six, ten, and in one case fifteen blows of the same drop, from the same extreme height, were required to break these bars. In another similar case the weight was dropped once from the former maximum height, then raised by inches until four more blows, each fall being one inch higher than the last, were delivered before breaking the piece. Subsequent tests gave still greater gains in strength."

In conclusion it was pointed out that "molecular annealing" differed from annealing in the oven in that it cannot change the chemical constitution in any way; and it is merely claimed that "every iron casting when first made is under a condition of strain, due to difference in the rate of cooling of the metal near the surface and that nearer the center, and also to difference of section; that it is possible and practicable to relieve these strains by tapping repeatedly the casting, thus permitting the individual metallic particles to rearrange themselves and assume a new condition of molecular equilibrium."

It is suggested in conclusion that all castings which are to be subjected to sudden and severe strains in actual service should never be tested at first up to anything like their full capacity. This applies to such castings as steam hammer frames, housings for rolls, and possibly to cast steel and all metal castings. The influence of shock upon the various forms of castings other than iron is now being made the subject of experiment.

Celestial Sights in June.

BY GARRETT P. SERVISS.

This is the month of the summer solstice. In June the sun attains its greatest northern declination, and the astronomical summer begins. The event occurs about 5 o'clock in the afternoon of the 20th, Eastern standard time. In the course of the month the sun will cross the Milky Way from Taurus to Gemini. During the first week the celestial "Bull," himself invisible in the blaze, will carry the god of day upon his "golden horns." At the end of the third week the sun will be received by Gemini, and at the time of the solstice will be close to the wonderful star cluster called M 35. Looking at the noonday sun in the middle of the month, it will be interesting to remember that Orion, with all his splendors of belt, sword, double stars, clusters and nebulæ, which made so brilliant a display during the winter evenings, is now hidden by the blue screen of the atmosphere just underneath the place occupied by the sun, and that if the latter should be suddenly extinguished, the surprising spectacle would be presented of the great luminaries of winter glittering through the warm summer air.

The majority of the planets are too near the sun, or too inconveniently situated, to be well seen this month. Mercury is low in the west, in the constellation Taurus, just after sunset at the opening of the month, but on the 10th it passes between us and the sun, emerging as a morning star after that date.

Venus is also in Taurus as a morning star, and at the beginning is situated about half way between the Hyades and the Pleiades. She is moving eastward and gradually gaining upon the sun, which she will overtake, in the center of Gemini, on the 8th of July. After that date she becomes an evening star.

Mars makes a long excursion through the constellation Pisces, passing into Aries at the end of the month. But, although it rises not long after midnight, it cannot yet be studied to advantage, even with the aid of a powerful telescope, because its distance from the earth is fully a hundred million miles greater than when the planet is in opposition.

Those who wish to see Jupiter during the present season must make haste. The great planet is sinking rapidly toward the western horizon, and, by the end of the month, will set as early as 9 o'clock. It is in Cancer, moving slowly toward the southeast, but it will not pass out of that constellation before disappearing from the evening sky. I append a few phenomena of its satellites:

June 2, 8:36 P. M. Satellite III begins a transit of the planet's disk.—9:05 P. M. The shadow of III enters upon the disk.—9:06:08 P. M. Satellite IV disappears in eclipse.—9:25:58 P. M. Satellite II reappears from eclipse.—June 16, 8:26 P. M. Satellite I begins a transit of the disk.—9:18 P. M. The shadow of I enters upon the disk.

Saturn is still near the star α in Libra, and during the month will move slowly westward. It is finely placed for telescopic observation, crossing the meridian about 9 P. M. in the middle of the month. A singular splitting up of the central bright ring into four parts, separated by exceedingly narrow divisions resembling faint hair lines, has been lately noticed in Europe. Similar phenomena have been observed in this ring at various times as far back as the days of Herschel. The most natural explanation of them seems to be that they are due to recurring variations in the disturbing attractions of the planet's satellites. These new divisions of the rings are hopelessly beyond the power of ordinary telescopes, but Ball's division, which always exists, can easily be seen.

An excellent opportunity is now presented for seeing some of Saturn's satellites. A good 4 inch telescope, under favorable conditions, will show five of them. The only certain way to distinguish between the satellites and small stars which may be near the planet is to carefully observe their motion from night to night. The fainter satellites can only be seen when near their greatest elongations from the planet. In order to facilitate their recognition I give the approximate times of elongation for the five satellites most easily seen, beginning with the nearest to the planet.

Tethys, eastern elongation, June 15, 10:26 P. M.; June 17, 7:50 P. M.

Dione, eastern elongation, June 12, 10:38 P. M.; June 23, 9:20 P. M.

Rhea, eastern elongation, June 1, 9:32 P. M.; June 10, 10:09 P. M.; June 19, 10:56 P. M.

Titan will be on June 3 east of the planet; on June 7 south, i. e., above as seen with an inverting eye piece; on June 11 west, and on June 15 north.

Japetus from the beginning of the month until the 13th will be seen moving eastward from the planet; after the 13th it will approach the planet, coming into conjunction with it on the south the 1st of July.

Uranus is in Libra, eight or nine degrees east of Saturn, but although visible to the naked eye, only the trained observer is likely to see it without optical aid. A strong opera glass will suffice. Those who care to see Herschel's planet can pick it up in this way: Find in Klein's Star Atlas, Map X, the little star marked "22," and, by the aid of the more conspicuous surrounding stars, locate it in the sky. Uranus, on June 3, will be just east of "22," and in the course of the following three or four days will pass close to the north of that star, moving in a direction somewhat north of west. A correct eye will easily detect the effect of the motion from night to night.

Neptune, in Taurus, comes into conjunction with the sun on the 7th.

June opens with a waning moon, which reaches last quarter on the morning of the 3d. The June new moon comes on the morning of the 11th; first quarter on the morning of the 18th, and full on the morning of the 25th. The moon will be nearest the earth on the night of the 20th and farthest on the morning of the 5th.

Following are the dates of the moon's planetary conjunctions for June:

Mars on the 5th, Venus and Neptune on the 10th, Mercury on the 11th, Jupiter on the 14th. This conjunction will be interesting. It occurs about 4:12 P. M., and with a telescope the observer will be able to see Jupiter in full daylight less than a degree south of the crescent moon. On the 21st the moon meets Saturn, and on the 23d Uranus.

Taurus, besides carrying the sun this month, will gain additional distinction from the maneuvers of the three planets, Mercury, Venus and Neptune, which will meet and pass (and in the case of Mercury and Neptune, meet and pass a second time) between his horns. Unfortunately, owing to the presence of the sun, these planetary conjunctions will not be visible. Their dates are: Mercury and Neptune, 14th, 7 P. M.; Mercury and Venus, 15th, 2 A. M.; Venus and Neptune, 15th, 5 A. M.; Mercury and Neptune, second meeting, 30th, 2 A. M.

The possessor of a telescope will find June presenting great attractions among the double stars. About 10 P. M. in the middle of the month Antares, in the Scorpion, will be well placed east of the meridian, and, with a steady atmosphere and keen eye, a 3½ inch glass may show the minute bright green companion of the great red star. A 4 inch, under good conditions, is certain to show it. The star β in the Scorpion is an easy and beautiful object with the smallest telescope. Farther east the Milky Way clusters in Sagittarius, and Scutum Sobieskii will be seen rising, and with nothing more powerful than a field glass one may catch a glimpse of their gorgeous sun swarms. Overhead at the same hour will be found the Northern Crown, and further east Hercules and Lyra, both crowded with beautiful telescopic objects, while dipped in the Milky Way below them appears the Northern Cross, with the exquisitely colored double Albireo in its foot. I have separated the orange and blue components of this star with a simple pocket telescope.

Ruling Diffraction Gratings.

"Rowland's grating" is made by ruling parallel lines on a concave plate of what is known as speculum metal. This metal is an alloy of two parts copper and one part tin. The parallel grooves are made with a delicately adjusted diamond point. The machine on which the grating was made was manufactured after eighteen months' hard work by Theodore C. Schneider, the machinist at Johns Hopkins University, from the designs of and by processes invented by Prof. Rowland, who was constantly at hand to direct every movement. This machine is in a dark vault under the laboratory. When a "grating" is being made, it runs night and day. The vault is locked, and no one is allowed to enter it, for the machine is so sensitive that the temperature of a human body would disarrange it. When a new diamond point is being tested, as is now the case, Prof. Rowland will permit a few people to visit it. Sir William Thomson, the Earl of Rosse, Lord Rayleigh, Prof. Ball, Astronomer Royal of Ireland, the late Prof. Helmholtz, of Berlin, Prof. Mascart, of Paris, and Prof. Lemstrom, of Sweden, are among those to whom this courtesy has been extended. The motive power of the machine is a hydraulic engine. The water is kept at a constant height in a tank near the roof, to insure unvarying speed. It is driven by a belt attached to a solid brass driving wheel on the machine. A crank is turned by the same on the other end of the shaft. This crank moves the carriage that conveys the diamond point back and forth over the surface of the "grating" or plate. This carriage rests on two steel ways, which are flat on top and slanting slightly outward, so that there are three points on one way or rail on which the carriage rests. These "ways" are ground so as to make them as nearly accurate as possible. But they cannot be made perfect, for Mr. Rowland tested them with a microscope and found that they were "out"—that is, not exactly perfect—by one fifty-thousandth of an inch. He did not attempt to improve them.—Appleton's Popular Science Monthly for May.

The National Electrical Exposition.

EDISON'S X RAY EXHIBIT, MOORE'S ELECTRIC DAY LIGHT, PHOSPHORESCENT DIAMOND.

One of the greatest attractions of this varied and interesting exhibition has been Mr. Edison's arrangement for the examination by every one of the skeleton of their own hands by means of the X or Roentgen rays. An improvised curtained room about twenty feet square is provided, illuminated by two red incandescent electric lights. On a platform in one corner is arranged a vertical fluorescent screen eighteen inches square of a composition best adapted to be affected by the rays, and fixed at a height above the floor of about five feet. Behind the screen about eight inches is a frame or screen of wood having a square aperture of about six inches. Just back of this is the vacuum Crookes lamp, or rather Edison's improved lamp. Lower down and to one side on a box is a Bunsen gas burner casting a bluish light upon the operator standing close by in his shirt sleeves.

The effect on entering the darkened chamber is somewhat weird, inasmuch as the blue light of the Bunsen burner reflecting from the white sleeve of the operator produces the impression that one is observing an X ray view of a human arm.

Back of the operator is the induction coil, and in another adjoining room is the interrupter. Directly in front of the fluorescent screen on the floor were two iron rails, between which the procession of two hundred or more persons passed two at a time, stopped, and were told by the attendant to place their hands behind the screen and then to watch as the operator turned on the current. As he did so, the current being on perhaps three seconds, the skeletons of the fingers were clearly observed. Exit was made at the other end of the room. Each time the current is turned on, a miniature fog horn sound is heard all around the place. It is reported that a man who had carried a shot in his hand, which could not be located by his physician, was among the procession of persons, and instantly saw, when the X rays illuminated his hand, that the shot was between his second and third fingers. The opaqueness of gold rings on the finger is very marked as compared with that of the bones.

Half hourly lectures were given illustrating on the screen many curious X ray shadowgraphs. Another attraction of interest was Mr. D. McF. Moore's daylight electric vacuum tubes, fitted up in a curtained room. The light is so much more diffused than the ordinary arc or incandescent light that it does not appear to be as bright to the eye, but photometric tests, we believe, prove it to be so. Many visitors crowded to see this. Tiffany & Company, through Mr. George F. Kunz, exhibited a peculiar phosphorescent diamond. In a darkened chamber, the light of an arc electric lamp passed through a blue glass lens and was allowed to strike the diamond for one or two seconds. It was then shut off, and the diamond glowed quite plainly in the dark chamber for about four seconds. The special fluorescent quality in the diamond causing that effect is termed by Mr. Kunz tiffanite.

One of the singular things missing in the exhibition was the absence of any trolley cars, their adjuncts and improvements.

A QUALITATIVE examination of the mineral species northupite from Borax Lake, California, shows that it is a double chloride and carbonate of sodium and magnesium.

A DUTCH TILBURY.

The accompanying illustration is from a photograph of an old Dutch tilbury of the eighteenth century. We give it as a curiosity and because of the study it affords of ironwork and carving. We are indebted to the Hub for kindly lending us the cut and particulars.

As will be observed, the ironwork is largely made up of flat instead of oval or round bars, and the scrolls show a narrowing of the bars to the ends. They evidence much artistic skill and excellence. The entire framework of the body is elaborately carved, while carvings and scrolls decorate the woodwork of the under carriage. The carved spokes and hubs evidence skill and originality. The scene on the panel would indicate that artists found opportunities for their genius on the vehicles of that day.

A DUTCH TILBURY OF THE EIGHTEENTH CENTURY.

The Temperature of the Sun.

Prof. Paschen has been investigating the temperature of the sun, says the Gas World. Among recent observers, Rosetti has found a temperature up to 10,000° C. by means of a thermopile; Le Chatelier one of 7,000° C. by comparing the absorption of solar rays with that of rays from a hot object; Wilson and Gray one of 6,200° C. by balancing the radiation from the sun against that from a glowing strip of platinum, in a Boys radiomicrometer; Scheiner one between 4,000° C. and 10,000° C. by measuring the breadth of the magnesium lines in the spectrum. Now Prof. Paschen reckons it by considering the wave length of the radiation of maximum energy in sunlight as inversely proportionate to the absolute temperature of an incandescent body; and this works out a solar temperature of 5,130° C. = 9,266° Fah.

OLYMPIAN TROPHIES.

We present engravings of trophies obtained at the recent revival of the Olympic games at Athens. We have already given views of the stadium and of the games, as well as a list of the events and the winners. The exhibition and recognition of physical excellence in action is the one permanent characteristic common to the old athletics and the new. The simple olive crown was felt to be a sufficient reward centuries ago when the interest in the games was at its height, but our modern ideas of sport and its reward have invaded even the classic precincts of the stadium; so the simple wreath, which is priceless in itself, carried with it in the present instance more substantial recognition. The larger of the cups was given to Robert Garrett, Jr., of Princeton University, for throwing the discus and the smaller for putting the shot. The discus shown in the engraving is the one actually used by Mr. Garrett on April 6, when he threw it 95·6 feet, defeating the Greek champion, Paraskevopoulos, by 7½ inches. It is 8 inches in diameter and about 2 inches thick in the center, becoming smaller toward the edges. It is made of wood with a brass plate on either side, and it has an iron rim. The smaller engraving represents the two medals, the face of one and the obverse side of the other. Each victor received one of the medals. Greece has commemorated the occasion of the revival of the Olympian games by the issue of an appropriately designed set of postage stamps.

BRONZE OLYMPIAN MEDALS.

The discus used in the games. Prize for throwing the discus. Prize for putting the shot.

OLYMPIAN PRIZES WON BY ROBERT GARRETT, JR.

Rising of the Land Around Hudson Bay.*

In the provinces of Ontario and Quebec it has been found by actual levelings by Gilbert, Spencer and Upham, that the old shore lines are not perfectly horizontal, but that they slope upward in a northeasterly direction at rates varying in different regions from one foot to even two feet per mile. If this upward slope were continued in the same direction to the northeastern extremity of Labrador, 1,300 miles from Lake Huron, the increase in the elevation might there amount to 1,000 or 2,000 feet.

The shores of the bay everywhere afford abundant evidence that there has been a comparatively rapid rise in the land, and that the elevation is still going on. It is well known to those who have paid any attention to the subject, that since the establishment of the posts of the Hudson's Bay Company in the mouths of the rivers around the bay, 200 years ago, there has been an ever increasing difficulty in reaching these establishments from the sea.

On the eastern side the most striking evidence of the rising of the land is afforded by the numerous well preserved and conspicuous terraces cut in the till and other deposits. Near the sea these may be seen at various heights, up to about 300 feet, but above this elevation the scarcity of soft material out of which terraces might be excavated renders this kind of evidence less apparent than it might otherwise be at higher levels.

On this side of the bay one of the best evidences that the elevation of the land is still going on is furnished by the long lines of driftwood which one sees in many places far above the reach of the highest tides. The old beaches on which this wood is plainly seen occur at various levels up to about 30 feet above high tide, but the remains of rotten wood may be detected in some localities up to nearly 50 feet, above which it has disappeared from the ancient shores by long exposure to the weather.

The gravel terraces seen at various elevations around the coves and upon the thousands of small islands along the east coast of James Bay are remarkably sharp and well preserved, and almost as fresh looking as if they had been formed but yesterday.

Some of the aboriginal geographical names around the head of James Bay are significant of considerable changes in the topography since these shores became inhabited by the natives who still occupy them. The large peninsula between Hannah and Rupert Bays is called Ministik-oo-watum, which means wooded island with a cove or hole in it, ministik being the Cree for a wooded island, and watum for a cove or hole.

One of the best evidences of the modern rising of the land is to be found in the beach dwellings of the Eskimos, which may be seen at all elevations up to about seventy feet.

Among the historical evidences bearing upon this question since the advent of the white man may be mentioned the fact that in 1610 Henry Hudson, the navigator, wintered in a bay full of islands on the east coast south of latitude 53°. None of the bays in this region would now be possible for this purpose, showing that a considerable change in the level of the sea has taken place in less than three hundred years.

The officers of the Hudson's Bay Company are an intelligent set of men, and their universal opinion, based upon lifetimes of observation, is that the land all around the bay is rising. The following is part of a letter recently received from Mr. Joseph Fortescue, lately a chief factor in the Hudson's Bay Company, in answer to my request for his opinion on this subject:

"Regarding the rising of the shores of Hudson Bay, I have no doubt whatever. When I was at York Factory I heard several Indians say that the sea or tide had retired two miles from places they remembered when they were young, and my own observations during twenty years there would lead me to entertain the same opinion. When I revisited Moose Factory after nearly forty years' absence I found a great change in the appearance of the coast and river. Channels which were navigable at all times of the tide formerly could now only be used at high water."

* From a paper read before the Geological Society of America, by Robert Bell, of the Geological Survey of Canada.

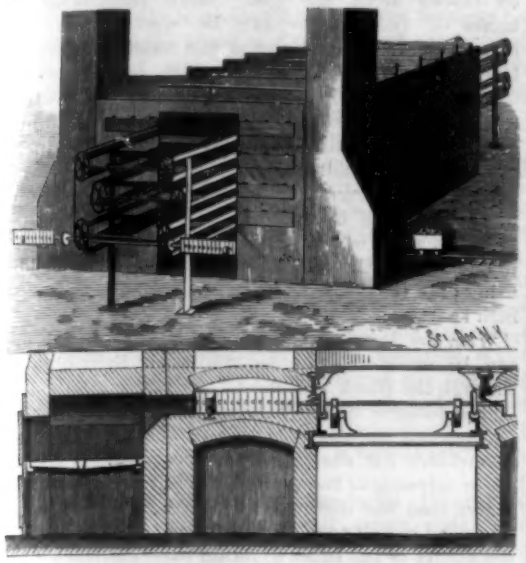
The Fortifications Bill.

The Fortifications appropriation bill passed by the Senate on May 20 carries nearly $11,000,000, an increase of about $5,000,000 above the amount actually appropriated by the House. The item for new gun and mortar batteries was increased by $3,115,000. It will be remembered that the Fortifications bill as passed by the House appropriated $5,842,337 to be expended outright, and gave authority to make contracts to the amount of $5,543,276 the total sum covered by the two provisions amounting to $11,385,613. This is over half a million dollars more than the sum now voted by the Senate. On the other hand it must be considered that the Senate bill gives the War Department full license to expend the whole sum during the twelve months; and looking to the question of further appropriations by the next Congress, it is argued that they will probably be more generous if a new appropriation is then asked for outright, than if such a request was preceded by a provision for $5,000,000 already authorized by a preceding Congress.

MR. WILLIAM I. HORNADAY, formerly of the National Museum, has been appointed director of the proposed Zoological Park in New York City.

THE WETHEY PARALLEL CALCINING FURNACE.

The improved furnace shown in the accompanying illustration has been patented by Mr. Arthur Harvey Wethey, of Butte, Montana. The object of the invention is to provide a new and improved calcining or desulphurizing furnace for rapidly and thoroughly desulphurizing ores and other material in a ground, crushed, pulverized, or concentrated state, and without loss or waste of material. The furnace consists of two parallel structures set about eight feet apart, and each having four floors or hearths opposite to each other. In the space between the two structures carriages are run which have laterally extending arms



THE WETHEY PARALLEL CALCINING FURNACE.

carrying rakes or plow blades for stirring and moving forward the ore lying in each compartment. The main outside brick walls are braced and strengthened by a stout skeleton structure of channels and I beams which serves to carry the load and bind the whole furnace together. This skeleton frame is one of the excellences of this furnace, as it prevents the sagging and splitting of the brickwork. The outside walls are braced by vertical channel beams, to which are strongly riveted the main horizontal I beams, which pass from outside to outside of the whole structure, and serve to carry the floors. To prevent their getting unduly heated, they are inclosed in air spaces. Upon them are laid a set of longitudinal three inch I beams upon which is placed sheet steel and a layer of brick, forming the floors or hearths. The inside wall of the furnace is divided by a horizontal slot for the passage of the arms of the plow, the lower half of the wall being formed by a channel iron upon which run the wheels of the plow carriages, the upper half being formed of an I beam, which is suspended from the main transverse I beam above, this I beam also carrying the inner footing of the arched roof of the furnace. Swinging doors are provided at the end of each hearth or compartment, so that the plow arms can pass into or out of the furnace as desired. The carriages with their plow arms are drawn across each floor and transferred from one floor to the other by means of a pair of endless chains which pass over sprocket wheels at each end of the furnace. Thus the plow, after passing through the top floor, stirring up and pushing forward the ore, passes out through the end door and over the end sprocket wheel. It then enters the furnace on the second floor, and so on until the lowest floor has been traversed, when it is returned again to the top floor. The above mentioned slot in the inner walls of the furnace is closed by a series of tripping doors, which open and close automatically as the plow passes. At the far end of each hearth is provided an opening through which the ore falls to the hearth below, and as the travel of the plow on each floor is in the reverse direction to that on the floor above, it follows that the ore is slowly pushed forward to the final discharge, where it is caught by the truck shown in the engraving. The heat inlet from the firebox is arranged near the final ore discharge and at the side of the furnace as shown, and the heat travels through the various hearths in a direction contrary to that of the ore, finally passing to the chimney by an outlet situated on the first or upper floor. The ore travels about 200 feet from the point where it enters the furnace to the point where it leaves it.

A New Method for Determining the Melting Point.

In the course of legal analyses, where it became necessary to examine carefully very small quantities of stearin and other candle material upon pieces of clothing, and where the quantity of material was so small that the use of capillary tubes was impossible, Van Ledden-Hulsebosch (Pharm. Weekblad) devised the following method: He laid small pieces of the cloth on which the fat was detected in a small aluminum capsule, and floated this upon water in a large beaker. He then heated this water bath very carefully, and suspended in it a thermometer so adjusted that only the upper portion of the water affected the thermometer. Slowly raising the temperature, he kept a close watch on the thermometer and upon the grease under examination, and was thus enabled to determine with considerable accuracy both its melting and congealing points.

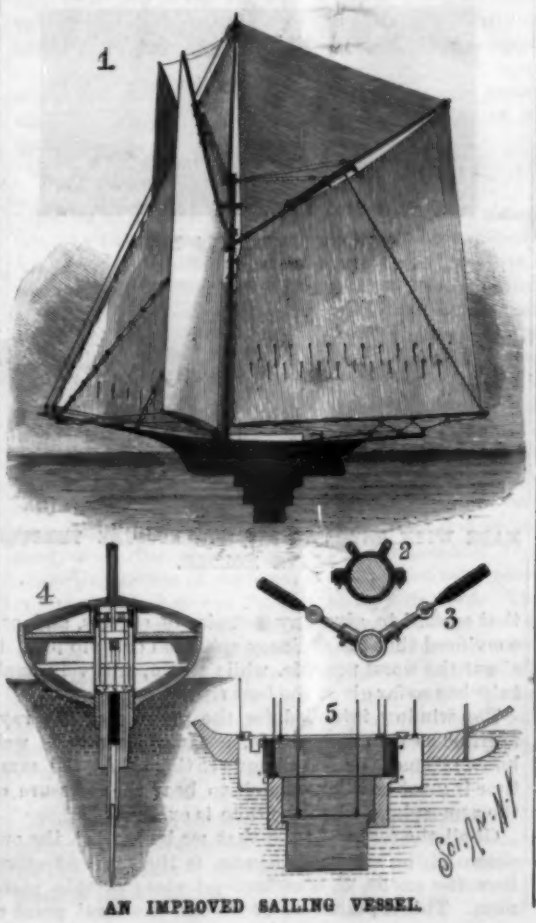
AN IMPROVED SAILING VESSEL.

An improved form of centerboard and new methods in the construction of spars and rigging are shown in the accompanying illustration of a sailing vessel. The various devices have been patented by Mr. William King, of New Orleans, La. By reference to the illustrations it will be seen that the stability of the vessel is increased by providing it with a telescopic centerboard which consists of a main centerboard within which is a double centerboard, an amidship centerboard carried by the double centerboard, and a port and starboard centerboard respectively carried on each side of the double centerboard, and within the main centerboard. When the boards are down to their full depth they are supported by lugs at their ends which engage ledges in the adjoining boards, and they are raised or lowered by cables which are actuated by winches conveniently arranged above the centerboard well. When the vessel is closehauled in a fresh breeze the board is lowered to its full depth as in Figs. 1, 4, and 5. When it is sailing free all the boards are housed within the well. If it is cruising with light sails or with a nearly fair wind, one or both of the port and starboard centerboards may be used. In this way the lateral plane and stability of the vessel may be regulated at will.

The spar plan and sail plan are also formed so that they may be enlarged or decreased at pleasure. This is accomplished by providing the spinnaker booms, and the gaffs of the mainsail and of the spinnakers, with auxiliary spars, sliding within suitable rings or sockets which are fixed near the ends of said gaffs and booms. These spars are adjusted by means of halyards and blocks, and can be reefed home or run out as desired, and a larger or smaller amount of canvas carried. Two spinnakers are used, and the booms are pivotally mounted on suitable steps which are placed one on each bow of the vessel. The spinnakers are not hoisted to the topmast as is usually done, but are provided with extensible gaffs, the heels of the gaffs being pivotally connected with a band, which is clamped upon the mast, as shown in Figs. 2 and 3. This connection has a universal pivotal movement. Should the topmast be carried away, one of the gaffs could be swung up into position and used in its place. These gaffs are hung from the topmast by the customary halyards and blocks.

The spinnaker booms are sheeted forward to the bowsprit end and aft to the outrigger as shown, and when they are not in use they rest in crutches at the end of the bowsprit.

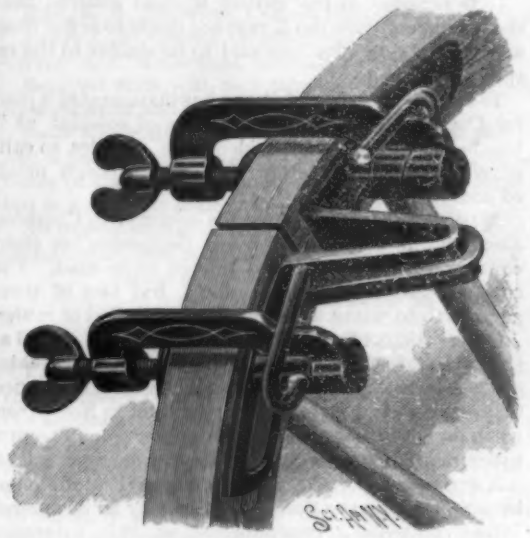
By the use of the two separate spinnakers the handling of the sails when running before the wind is simplified, and the dangerous operation of "gybing" is avoided. A stout outrigger is provided at the stern upon which the blocks of the main sheet are fastened, the long boom being greatly stiffened thereby.



AN IMPROVED SAILING VESSEL.

A RIM CLAMP FOR WHEELS.

An improved clamp for use in the manufacture of the rims or felloes of wheels, which has been patented by Mr. Charles Schalles, of Cortez, Colorado, is shown in the accompanying illustration. It consists of a body bar, which is T shaped in section, and is provided at the middle of its length with a deep, laterally extending arch. On each side of the arch a bearing surface is formed, which is provided with a hole to receive a sliding spindle or pin. Associated with the body bar are two clamps or yokes, at one end of which are provided adjusting screws, which terminate in flat swiveling heads or bearing plates. The outer end of the yoke carries a spindle, which projects



A RIM CLAMP FOR WHEELS.

inwardly and lies in the same axis as the above-mentioned adjusting screws. Upon this spindle is arranged a lock lever, and the adjacent faces of the lever and the clamping yoke are formed spirally, so that when the lever is thrown over across the yoke, as seen in the illustration, it will cause the lock to travel in the direction of the adjustment screws, and so exercise a clamping action upon the bearing surfaces of the body bar. In applying the clamp the lock levers are thrown back and the body bar is placed across the joint so that the abutting ends of the rim will be directly opposite the laterally extending arch. The bearing plates are brought snugly up against the opposite side of the rim, and the clamp is then tightened by turning the cam levers into the position shown in the cut. By this device the abutting ends of the rim sections may be accurately trimmed with a saw, for being rigidly held in position they cannot twist and bind the saw. The invention is also capable of attachment to wheels of different widths, and it provides a means for locking the clamps independently, so that one section may be loosened and allowed to assume its proper position relative to the clamped section, thus facilitating inspection of the joint.

The Appellate Justices Decide Against the Broadway Tunnel Scheme.

The question of rapid transit for New York City has taken one step forward, or backward, according as the citizens may individually regard the recent ruling of the justices of the Appellate Division of the Supreme Court against the proposed tunnel beneath Broadway, New York. The Broadway scheme as submitted by the Rapid Transit Commission and indorsed by the Supreme Court Commission is vetoed with unusual emphasis, and the decision is one from which there is no appeal. The ruling states that "the most serious question is that of cost," and it dwells upon the fact that "after all the investigation which the Court Commissioners made upon the subject, they were entirely unable to come to any conclusion as to the probable expense;" and it points out that the cost of construction in any case would pass the city's debt limit.

The public will now turn naturally to the late proposition of the elevated roads as affording the only immediate prospect for enlarged transit facilities. It is the intention of Mayor Strong to submit the proposals of Messrs. Gould and Sage for an extension and enlargement of the facilities of these roads to the Rapid Transit Commission, and it is to be hoped that the scheme will be indorsed and pushed through to completion at an early date. It would appear to be the general sentiment that an underground system of transit is only to be regarded in any case as a "dernier ressort;" but while the sentiment is reasonable and strong, we think that the statistics of the city's growth give reason to believe that we shall be driven to this extremity sooner than is generally supposed.

Two trees, 125 feet from each other, at Gainesville, Ga., were recently struck and shattered by a single bolt of lightning.

Science Notes.

In the ocean, at a depth of 500 feet below the surface, the sun has an illuminating power about equal to the light of the full moon.

Dr. Behring has donated the 25,000 francs he received from the "Albert Levi" prize to establish a fund for sero-therapeutic research.

The deaths from alcoholism in Sweden amount to 90 per thousand. This is the highest rate in the world, says the Medical Record.

The German Emperor has had his left arm "skiagraphed" preparatory to an operation which is expected to give him partial if not complete use of the now useless member.

It is reported in the British Medical Journal that those working with the X rays are likely to suffer from a variety of skin affections said to be similar to the results of sunburn.

The Medical Society of Berne has inaugurated a plan for the suppression of press notices of suicides, as it has been observed that epidemics of suicides, so called, come from "suggestion," acquired through printed accounts of them.

A peculiar case of rabies has occurred in Cheshire, England. A black retriever last September bit eight cows, and after being killed proved to be mad. The cows showed no sign of madness, but two of them gave birth to calves which undoubtedly died of rabies.

Observations taken during the second half of 1895 at the observatory of the Roman College by Tacchini show that during this period sunspots have continued to decrease with a secondary minimum in November, when days without sunspots were observed. The protuberances have shown very little change during 1895.

A curious property of potassium uranyl sulphide has been reported to the French Academy by M. Becquerel. When excited to phosphorescence, this substance emits rays which last a long time—more than 160 hours—after phosphorescence ceases, which pass through paper, aluminum and copper, and which discharge electrified bodies like the Roentgen rays.

The discomfort produced by crowded, ill-ventilated rooms, in persons not accustomed to this condition of things, is not due to the excess of carbonic acid, nor to bacteria, nor, in most cases, to dusts of any kind. The two great causes of such discomfort, though not the only ones, are excessive temperatures and unpleasant odors.—Drs. J. S. Billings, S. Weir Mitchell, and D. H. Bergen in Smithsonian Contributions.

The researches of M. Moissan show that yttrium forms a carbide of the formula C_2Y. It occurs in transparent crystals decomposable by cold water, with formation of a gaseous mixture rich in acetylene, and containing methane, ethylene, and a small quantity of hydrogen. Thorium also forms a crystalline and transparent carbide, C_2Th, which is also decomposed by water, producing gaseous carbides, poorer in acetylene, but richer in free hydrogen.

Mount Mauna Loa, in the Sandwith Islands, was in violent eruption at 7 o'clock on the morning of April 20. The fountain of lava, flame, and ashes on the summit of the mountain was estimated by observers at Hilo as 4,000 feet high. The light was so brilliant that it was seen from Lahama, 110 miles away, the next night, and the glow was seen at Diamond Head, 180 miles distant. This indicates an eruption of the greatest magnitude.

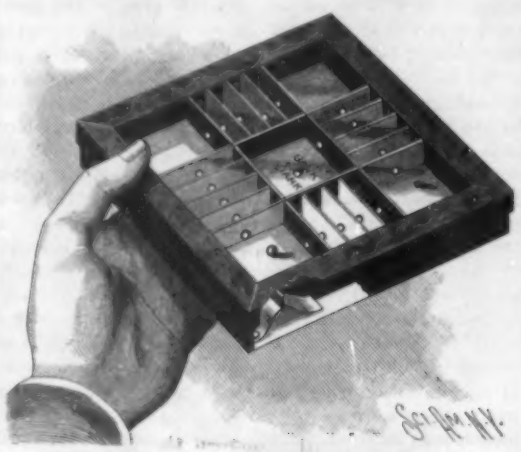
The first edition of Prof. C. A. Young's work on "The Sun," published in 1881, mentions twenty-one elements as having been detected by the spectroscope in the sun. In all of these 880 lines had been identified. The new edition of Prof. Young's book states that Prof. Rowland has now compared sixty elements with the solar spectrum, and established the existence of thirty-eight of them in the sun, being doubtful in regard to eight of the others. Of iron lines alone he has identified more than two thousand.

M. Moissan, in France, has analyzed specimens of opium as used by the Chinese, says Knowledge, and finds that the smoke is formed of volatile perfumes and a small quantity of morphine. It is the latter which produces the phenomena sought by opium smokers, and it is said that they do not appear to find more ill effects from the practice than most tobacco smokers, provided that they use the preparation known as chandu of the best quality. The commercial quality of opium is, however, very different, and the inferior sorts when decomposed by heat produce various poisonous compounds.

An egg of the now extinct great auk was recently sold in London for 160 guineas, although the shell was slightly cracked. So rare and consequently so valuable are these eggs that each one has a history. The one in question was purchased in 1841 from Frederick Schultz, of Dresden. In the Newcastle Natural History Museum, which possesses one of the finest collection of sea birds in Great Britain, the curator keeps in a locked drawer what appears at first sight to be a large number of great auks' eggs. But only one is a real specimen, the rest are chalk or plaster models of other existing treasures, and so good are the imitations that only a practiced eye can detect the real from the sham, handling being, of course, prohibited.

THE THIEF AND DETECTIVE PUZZLE.

The puzzle shown in the accompanying cut has been patented by Mr. Oscar Beisheim, of New York City. It consists of a shallow box, which is divided by thin partitions into a series of streets and squares, whose arrangement will be seen in the illustration. All the partitions are perforated to allow passage from one street or square to another, the perforations being of two sizes to match the sizes of two balls which are supposed to respectively represent a detective and a thief, the thief being able to traverse all the streets and openings, the detective being restricted to movement in a predetermined path. Within the side street, on



THE THIEF AND DETECTIVE PUZZLE.

one side of the box, two coverts are arranged, having perforations in the roofs, through which the thief only will pass, and within the side street on the opposite side is provided a spring keeper, adapted to cover and retain the detective. A money vault or safe is supposed to be located in the central square. The box is provided with a glazed top, which allows all of the interior to be seen, except the four side streets. The puzzle is handed to the player with the thief inside the covert and the detective held by the keeper. To solve it he has to start the thief on his way to the bank, and set the detective after him in pursuit. This is done by inverting the box, when the thief will roll out of the hole in the covert, and by slightly raising the corner of the lid, which will release the keeper and permit the detective to roll into the street. To solve the puzzle, the player must now bring the thief and the detective together in the central square or bank.

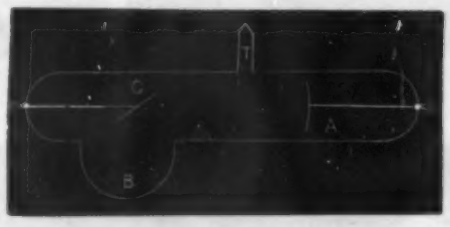
IMPROVEMENTS IN CROOKES TUBES.

BY C. C. HUTCHINS AND F. C. ROBINSON, BOWDOIN COLLEGE.

During the last two months every college, high school and private individual that could procure an induction coil and a Crookes tube has been making pictures of hands, coins, keys and such things in endless variety.

At Bowdoin College a long series of experiments has been in progress with a view to improving the tubes.

We have made and tested every shape and variety



IMPROVED CROOKES TUBE.

MADE WITH ONE-HALF SECOND EXPOSURE THROUGH PLATE HOLDER.

that seemed to give any promise of success, and are convinced that the ordinary spherical or bulb form is about the worst possible, while a comparatively small tube has so far given the best results.

The window intended for the passage of the rays must be as thin as possible, because glass, as is well known, is more or less opaque to them. At the same time it must be thick enough to bear the pressure of the atmosphere when the tube is exhausted.

Of all the forms of tube that we have tried, the one shown in the annexed diagram is the most effective. Here the anode, C, is an inclined plate of thin platinum. This is placed at or beyond the focal point of the cathode, A. This piece of platinum becomes red hot, and is, as far as can be judged, the source of the ray. It is a curious fact that the anode, C, if made in the form of a thin plate, may nearly fill the tube without in any way obstructing the passage of the rays out at the bulb. The bulb is filled with an intense green fluorescence, and sparks can be drawn from it by approaching the finger.

Not only do these tubes give remarkable results in the way of intensity of rays, but also extremely fine definition.

The cellular structure of the bones is clearly brought out and the course of the tendons can be traced along the arm. Good pictures of the bones of the fingers can be obtained in from five to thirty seconds, and of the hand and wrist in from one to ten minutes.

Mr. Edison, in the current number of the Century, states that a good tube should give a distinct impression upon the photographic plate through eight inches of pine in fifteen minutes.

We have photographed metallic letters through ten inches of pine in five minutes; while such objects as keys and coins can be satisfactorily done in one-tenth to one second through the slide of the plate holder, using only the ordinary induction giving a five or six inch spark.

With the fluoroscope the bones of the arm, leg, etc., can be minutely examined, and clear light obtained through the trunk and chest.

[The pictures to which reference is made show the texture and cellular structure of the bones, and are remarkable for sharpness and clearness. They are far in advance of the usual X ray silhouettes, and we regret that the distinctive features could not be reproduced in half tone. In response to our query as to the ability of the tubes to retain their efficiency, Prof. Hutchins informs us that "if the vacuum becomes too high by use, it is only necessary to heat the tube a little."—EDS.]

Signs Among Savages.

If no serious writer tells of a people actually dumb, plenty even at this time assert that there are races which cannot converse among themselves without the assistance of gestures. We hear of them east of Cape Palmas, in Tasmania, Ceylon, Brazil, South Africa, North and South America, and upon excellent authority. But confirmation of the report does not arrive in such volume as we should expect at the present day, when thoughtful and observant travelers swarm in every quarter of the world. The most striking case is that of the Arapahoes, because it has the guarantee of Sir Richard Burton, not because it is most impressive in itself. He says that these red Indians must rise and sit by the camp fire when they wish to talk at night, or must kindle a fire for the purpose. But Burton could not possibly have been speaking of his own knowledge, for he spent a very short time—six weeks, if we remember right—in galloping through "the plains." His account of all such matters as this must have been hearsay. But there is no doubt that many savages would be embarrassed if they could not assist the transmission of their ideas by gesture. One could hardly fancy a Bushman talking without grimaces and motions at every syllable. But the serious interest of gesticulation lies in the identity or the difference of its forms in various parts of the world. Such strange and unaccountable resemblances have been noted among races as far remote from one another as could be, and so many of them appear in deaf mutes of civilized Europe that one may almost be tempted to think mankind had a natural language after all, but one—or perhaps two—of gesture, not speech. It may be confidently assumed that some earnest and laborious student will go into this subject thoroughly one day; perhaps he is now at work. It would be his task to gather lists of signs used by divers people, and compare them. Burton collected some; a vast number of travelers record a few. Dr. Tyler has noted many which coincide with those used by deaf and dumb persons—either their own individual discovery or adopted into their system of education. Thus he found that the signs for hiding, seeing, mother and sister, yes and no, truth and lie, food, think, trade, day, etc., recorded by Burton among the red Indians, were quite intelligible to deaf mute children in Berlin, where his studies were made. This is most extraordinary, if one think of it. And he gives some practical illustrations upon the authority of American experts. A native of Hawaii was taken to an asylum, and forthwith began to "chatter" volubly, telling the inmates all about his country and his voyage. A Chinaman who could speak no language but his own had fallen into a state of melancholy. Introduced to a number of deaf and dumb children, he became quite vivacious, talking and answering. And we have a letter from a deaf and dumb boy taken to see some Laplanders. He spoke to the woman by signs, "and she understood me. . . . She did not know we were deaf and dumb, but afterward she knew, and then she spoke to us about reindeer and elk, and smiled at us much."—London Standard.

THE MANUFACTURE OF GUNS AT THE WASHINGTON NAVY YARD.

The modern built-up breech loading rifle for service on land and at sea has developed into a very complicated structure, requiring the highest degree of mechanical skill and perfection of tools for its construction. While the rule has been for foreign governments to depend largely on private or ostensibly private concerns as manufacturers of their ordnance, the United States government have embarked with great success upon the business of manufacturing its own guns, both for army and navy use. Army guns are assembled at Watervliet Arsenal, near Troy, New York, and guns for the navy at the Washington, D. C., Navy Yard. At these establishments the forgings for the tubes, jackets, hoops and other parts are received rough finished and oil tempered from the forges, which make them under government supervision. The rest of the operation is done by the government.

The guns for navy and for army use follow essentially the same lines of construction and the tools used in their manufacture are largely identical. Our illustration shows the great 16 inch gun lathe at the Washington Navy Yard, a typical piece of its class and built by the William Sellers & Company, of Philadelphia, Pa. The lathe is used for two essentially different purposes, the one for turning the outside surfaces of the different parts of the gun, in which role it operates as an ordinary lathe does; the other operation is the boring and reaming of the interior of the different pieces of the gun. The interiors are attacked by tools carried on a long boring bar, which tools are of the drill or reamer type. The rifling, a special operation, is analogous to planing.

The lathe bed is divided into two parts. One carries the headstock, tool carriages and steady rests; this portion is 73 feet 10¾ inches long, 9 feet wide and 2 feet deep, made in two sections bolted and keyed together. On this bed are executed all the external turning operations. In prolongation of this bed comes a second or narrower part, which carries the boring bar. This part is 54 feet 5 inches long, 5 feet 2 inches wide and 2 feet deep. To give an idea of the size of the headstock, the dimensions of the main spindle may be cited. Its front bearing is 20 inches diameter, its rear bearing is 14 inches diameter, and the distance between the bearings is 6 feet 9 inches.

The spindle is driven by an 8 inch belt, working on a 7 step pulley, whose diameters range from 20 to 60 inches. The center of the main spindle is 4 feet above the bed. A fixed screw extends along the length of the headstock section of the bed. Each of the two tool carriages carries a long nut which works on this screw. Parallel with the screw are two square shafts, which are rotated from the headstock. These shafts operate the nut, and, according to which one is thrown into gear, the carriage is fed slowly as the tool is cutting or is rapidly traversed back to the beginning of its work. The square feed shaft also feeds the cross slide. By changing the gears on the carriage, the ratio of longitudinal and cross feeds can be modified so as to get nearly 100 different tapers with simultaneous feeding, and, by extra gears, the ratios may be varied almost indefinitely. The swing of the lathe is 70 inches over the carriages.

Four steady rests for the following diameters are provided: 61 inches, 54 inches, 40 inches and 27 inches. By a coupling bar a steady rest can be attached to a carriage so as to be traversed or shifted as required.

The tailstock spindle is 14 inches in diameter and has a steel center 8 inches in diameter. Back of the tailstock is the boring bench, which carries the boring bar on a fixed rest at the front end of the bed, and on three slide rests distributed along it. A very ingenious feature of the boring mechanism provides for the rotation of the boring bar in the opposite direction to that of the gun, so that the boring rate is independent of the turning rate, it being understood that, as usual, the rotation of the gun effects the boring. Thus boring and turning can be simultaneously carried on upon the same piece.

A 16 inch gun consists of a number of distinct pieces. Its basis is a tube the full length of the gun. This tube is first placed on the lathe and brought up to its proper position between centers in order to allow for any possible warping. It is now bored, there being perhaps as much as half an inch of metal to be removed during the boring operation. The finish reamings are given with a reamer consisting of a stock whose head carries a block of hard wood soaked in oil, turned to shape and provided with steel cutters. By these tools the bore of the gun is perfected. Before the final finish reaming the tube is turned on the outside.

In this operation the gun is supported at some intermediate point with steady rests, for whose operation seats are turned upon the exterior of the gun. One of these steady rests, with its block bearing surfaces, is seen prominently displayed. The surface is first rough turned to within about 0·03 of an inch of the shrinkage diameter. The final turning is given with a square nosed tool about an inch wide, and here the utmost accuracy must be observed, no variation exceeding 0·003 of an inch being tolerated. Over the inner tube is shrunk a heavy tube which is termed a jacket, and a number of other tubes superimposed and rabbeted at the ends, termed hoops. Each one of these is prepared on the same lines as just described for the tube, each one being accurately bored and reamed and its exterior turned down with the greatest exactness. For hoops and jacket the general principle is followed that boring and finishing the interior surfaces precedes the final turning of the exterior or shrinkage surfaces.

The hoops and jacket are a little less in interior diameter than the exterior diameter of the cylinder which they are to embrace, about a hundredth of an inch shrinkage per linear foot of diameter being allowed. To put a hoop in place, the part destined to receive it, which may be the interior tube or may be the partially hooped gun, is set up on end in a special centering pit near the furnaces. The hoop is heated in a furnace whose fuel is raw petroleum actuated by a blast. As the piece gets hot its diameter is constantly tested by means of a species of interior calipers termed a fixed star gage. As soon as it has become large enough it is lifted out of the furnace and is lowered into place over the vertically supported gun. These operations are rendered very easy of accomplishment by the very perfect system of cranes employed.

The gun is again put in the lathe chuck, and supported by steady rests and prepared for a new hoop. In this way it is gradually built up. It is to be observed that the shrinkage surfaces are left as they come from the squarenosed tool in the lathe. They are not touched with the file or emery paper. The shrinkage operations slightly diminish the bore, indicating what a tremendous power is exerted by the hoops, and necessitating a final finish reaming of the bore before rifling.

When all the hoops are in place the exterior of the gun is turned in the lathe to its final shape, and then it is gone over from one end to the other with files in the hands of the workmen as it turns in the lathe, so that its exterior surface leaves the shop as perfectly hand finished as any piece of fine machinery.

The interior has to be bored and reamed out to provide an enlarged powder chamber at the breech end. In the 12 inch gun this is about 6 feet long and about 2 inches larger in diameter than the bore of the gun. Then a conical slope 18 inches long comes between the forward end of the powder chamber and the bore of the gun. This is not all. To enable a projectile to enter the bore and for its packing rings to fill the grooves, what is termed the forcing slope must be bored out. This consists in a very slight enlargement of the bore, with a very slight taper at the breech end, over a distance of some 4 feet in the 12 inch gun. This increases the bore at the rear end of the forcing slope a little over 0·05 of an inch, reducing, of course, to zero at the forward end. The complicated breech mechanism has to be provided for by the cutting of the interrupted screw, the gun has to be rifled and at last is complete.

It is needless to say that throughout the most severe inspection is exercised. The bore of the finished piece is calipered by a very ingenious apparatus termed the star gage, which reads to 0·001 of an inch by vernier. With this instrument readings are taken for every inch of length of the gun and in two or three series, so that 400 or more star gage readings are regularly recorded for every large gun. The interior is subjected also to ocular observation by means of an inclined mirror and an incandescent light, which is passed through the gun and enables every particle of its interior to be carefully observed.

An Indication of Foul Air.

In the Zurich industrial exposition, says Gaea (translated by the Literary Digest), an air tester is exhibited which shows whether and in what degree the air in a workshop is contaminated. The apparatus consists of an airtight closed glass vessel filled with a red fluid. Through a glass tube that dips into the liquid and is bent at the top, a drop falls every one hundred seconds on a cord that hangs beneath and that is somewhat stretched by a weight. The fluid from which the drop comes has the property of changing its red color to white by the action of carbonic acid. The more carbonic acid there is in the air, the quicker this change in color takes place. If the air is very foul, the drop becomes white at the upper end of the cord, while the change of color corresponding to a slight proportion of carbonic acid does not take place till the drop has run farther along the cord. The exact condition of the air can be ascertained by observing a scale that is placed alongside the cord and that is divided into convenient parts, bearing the designations, "extremely bad," "very bad," "passable," "pure." This is surely a very useful device, and should be found in every factory, every workshop, and every place where persons are crowded together.

THE Electro-technical Institute of Darmstadt, Germany, has received about $100,000 from the government for the purchase of new ground and for the enlargement of the buildings.

Notice.

A premium of $250 is offered by the SCIENTIFIC AMERICAN for the best essay on

THE PROGRESS OF INVENTION DURING THE PAST FIFTY YEARS.

This paper should not exceed in length 2,500 words.

The above-mentioned prize of $250 will be awarded for the best essay, and the prize paper will be published in the Special 50th Anniversary Number of the SCIENTIFIC AMERICAN of July 25. A selection of the five next best papers will be published in subsequent issues of the SCIENTIFIC AMERICAN SUPPLEMENT at our regular rates of compensation.

The papers will be submitted for adjudication to a select jury of three, consisting of—

Prof. R. H. Thurston, Cornell University.
Judge A. P. Greeley, Washington.
Prof. R. S. Woodward, Columbia University.

Rejected MSS. will be returned when accompanied by a stamped and addressed envelope.

Each paper should be signed by a fictitious name, and a card bearing the true name and the fictitious name of the author should accompany each paper, but in a separate sealed envelope.

All papers should be received at this office on or before June 20, 1896, addressed to

Editor of the SCIENTIFIC AMERICAN,
361 Broadway, New York.

Longevity of Animals.

The Literary Digest translates the following from the Journal d'Hygiene: Man lives to all ages, but in the animal kingdom, on the contrary, the duration of life is almost exactly equal for all individuals of the same species. But we can know with exactness the real duration of life only for animals in servitude; we do not know whether it is the same in the savage state. Rabbits and guinea pigs live 7 years; squirrels and hares, 8; cats, 9 or 10; dogs, 10 or 12; foxes, 14 to 16; cattle, 15 to 18; bears and wolves, 20; the rhinoceros, 25; the ass and the horse, 25 to 30; the lion, 30 to 40 (a lion in the London Zoological Gardens reached the age of 70 years); the camel, 40. The length of life of the elephant is uncertain; according to Aristotle, Buffon, and Cuvier, it lives two centuries; some authors say even four or five. After his victory over Porus, Alexander consecrated to the sun an elephant that had fought for the Indian monarch, and gave it the name of Ajax; then, having attached an inscription to it, he set it at liberty; the animal was found 350 years later. The ancients attributed to the stag a fabulous length of life, but Aristotle observes that what is reported on this subject has no good foundation. . . . Buffon says that the stag takes 5 or 6 years to attain full growth and should live seven times this period, that is, 35 or 40 years.

Though precise observations are wanting, we know that fishes, especially the large species, live a very long time. According to Bacon, eels reach 60 years. Carps have been known to live at least 150 years, and they then seemed to Buffon as lively and agile as ordinary carp. Dolphins, sturgeons, and sharks live more than a century and attain huge size. Pikes have been seen weighing 1,000 pounds, which indicates a very long existence. A pike caught at Kaisers-Lautern in 1497 was 19 feet long and weighed 350 pounds; it bore in its gills a copper ring with an inscription stating that it had been put in the pond of Lautern by order of the Emperor Frederick II, that is, 261 years before. Whale fishers have exterminated the huge whales of the polar seas; those that were formerly met with were of prodigious dimensions. It is supposed, with some probability, that they live several centuries and that they may even reach an age of 1,000 years.

On the other hand, we meet another class of animals whose passions are lively, whose vitality is very active, and who still live a long time—we mean birds. But it is not known with any degree of precision how long these live, except that their longevity is great. We see the same swallows returning to their accustomed nest for a considerable number of years. An eagle died at Vienna at the age of 103 years. According to Buffon, the life of the crow is 108 years, and no observation authorizes us to attribute to it, with Hesiod, 1,000 years. A paroquet, brought to Florence in 1633 by the Princess Provere d'Urbin, when she went there to espouse the Grand Duke Ferdinand, was then at least 20 years old and lived nearly 100 more. A naturalist whose testimony cannot be doubted, Willoughby, had certain proof that a goose lived a century; and Buffon did not hesitate to conclude that the swan's life is longer yet; some authors gave it two and even three centuries. Mallerton possessed the skeleton of a swan that had lived 307 years. This is quite enough to prove that among the larger animals, and also especially among birds, the duration of life, relatively to their bulk and height, is very long; it is, on the contrary, very short with insects; many of these live less than a month, rarely a few years, while the life of the ephemerids is but 7 to 12 hours, and in this brief space they accomplish the principal functions that nature requires of organized bodies—they are born, reproduce, and die.

EDWARD JENNER, M.D., AND THE VACCINATION CENTENNIAL.

BY JOSEPH H. HUNT, M.D.

The English town of Berkeley, in the County of Gloucester, is not only noted for its famous cheese, known as "Double Gloucester," and for its castle, which was the scene of the barbarous murder of Edward II, but also for having been the scene, a hundred years ago, of the first vaccination, and thirty-five years previous (1749) the birthplace of its discoverer, Edward Jenner.

The important matter was first communicated by its discoverer, in the following letter to a friend:

"Dear Gardner: As I promised to let you know how I proceeded in my inquiry into the nature of that singular disease, the cowpox, and being fully satisfied how much you feel interested in its success, you will be gratified in hearing that I have at length accomplished what I have been so long waiting for, the passing of the vaccine virus from one human being to another by the ordinary mode of inoculation.

"A boy of the name of Phipps was inoculated in the arm from a pustule on the hand of a young woman who was infected by her master's cows. Having never seen the disease but in its casual way before, that is, when communicated from the cow to the hand of the milker, I was astonished at the close resemblance of the pustules. But now listen to the most delightful part of the story. The boy has since been inoculated for the smallpox, which, as I venture to predict, produced no effect. I shall now pursue my experiments with redoubled ardor. Believe me yours very sincerely, EDWARD JENNER."

Berkeley, July 19, 1796.

This is the event the centennial of which is just now being celebrated in all parts of the world. In Russia a life of Jenner and a medal is to be issued; in Berlin the medical profession will issue a medal; and in Bristol, England, they are celebrating the centennial by acquiring for the city the famous Mockler collection of Jenner relics; while in this country, Baltimore, Newport, the State of Pennsylvania, represented by its health board, and State Medical Society, met at Marietta, on May 22, to celebrate the discovery.

In the city of Brooklyn the medical profession held a banquet on the 14th inst.; there were orations by Bishop Potter, Provost William Pepper, M.D., of the University of Pennsylvania, Prof. William Welch, M.D., of Johns Hopkins University, and others, besides issuing an ornate bronze medal, a picture of which is shown. The bronze medal struck by the Medical Society of the County of Kings was made from an old print of Dr. Jenner. The print was covered with mica and divided off into squares in the manner shown in the small engraving. The large portrait of Dr. Jenner is from a rare German print.*

Of Edward Jenner, the immortal discoverer of vaccination, a writer has said: "Among all the names which ought to be consecrated by the gratitude of mankind, that of Jenner stands pre-eminent. It would be difficult, we are inclined to say impossible, to select from the catalogue of benefactors to human nature an individual who has contributed so largely to the preservation of life and to the alleviation of sufferings."

He was the son of an English clergyman, and he says of himself: "I have been the only one of a long line of ancestors and relatives who was not educated at Oxford." And it may be due to that fact that he early cultivated his powers of observation in the study of nature among his native meadows instead of the classic halls of a university, that his faculties of observation and induction were developed instead of those of erudition and speculation. The other great factor in the development of this man and his great discovery was the fact that he, at the age of twenty-one, became the pupil and assistant of John Hunter, in whose house he resided for two years. This was a fortunate crisis in Jenner's life; the spark of observation was latent in his mind, and Hunter supplied the friendly breath. The friendship at that time formed continued through the remainder of Hunter's life, and it is noteworthy that the first to describe the pathology of angina pectoris as a disease of the coronary arteries was Jenner, whose studies were incited by the sufferings of his honored preceptor from the disease which terminated his life, and whose coronary arteries were found in the condition that Jenner had predicted. In his earlier days Jenner was somewhat known as a poet, and his poem on the "Signs of Rain" has been frequently reprinted, and shows accurate observation of the phenomena of nature.

As a naturalist he was even better known, and a number of his papers had been well received and published in the Transactions of the Royal Society. That on the influence of the earthworms and their influence in breaking up the soil and fertilizing it for cultivation was the first to call attention to this now well recognized fact. His researches into the habits of the cuckoo and other birds are often quoted. But we are told when Jenner attempted to lay the subject of vaccination before the society the president gave him to understand that "he had already gained some credit by his communications to the Royal Society, and he ought to be cautious and prudent and not risk his reputation by presenting to that learned body anything which appeared so much in variance with established knowledge and withal so incredible." His first public communication on the subject was in June, 1798, and entitled: "Inquiry into the Cause and Effects of the Variolæ Vaccinæ." Although his attention was first directed to the subject when he was a medical student, previous to 1770, his first successful vaccination was made on the 14th of May, 1796, when Jenner inserted lymph taken from the hand of Sarah Nelmes, who was infected with cowpox, into the arms of James Phipps, a healthy boy about eight years of age. On the 1st of July following the attempt was made to inoculate him with the smallpox virus by introducing the "matter" into his arm, but no effect followed. The importance to humanity of the era which that day (May 14, 1796) began may be appreciated by those who recall the days when the description given of the terrors of the loathsome disease was not an exaggeration. "The smallpox was always present, filling the churchyards with corpses, tormenting with constant fears all whom it had not yet stricken, leaving on those whose lives it had spared the hideous traces of its power, turning the babe into a changeling at which its mother shuddered, and making the eyes and cheeks of the betrothed maiden objects of horror to the lover." A hundred years ago London had a population considerably less than that of Brooklyn to day, yet statistics tell us that smallpox annually destroyed 1,200 of her population; and that Vienna, with less than a quarter of our number, lost in the year 1800 no less than 835. In the city of Paris there were, in 1719, 14,000 deaths from smallpox. In 1768 69 one-half the inhabitants of Kamschatka perished with the disease. In 1733 it almost depopulated Greenland, after having in 1709 carried off more than a fourth part of its inhabitants; and we are told that when the Spaniards introduced their religion into the land of the Aztecs they brought with it the smallpox, which did far more than the cruel swords of Cortez and his band of invaders to "civilize" the country; killing off in one year 3,500,000 of the natives—nearly one-third the number of the present population of the Mexican republic.

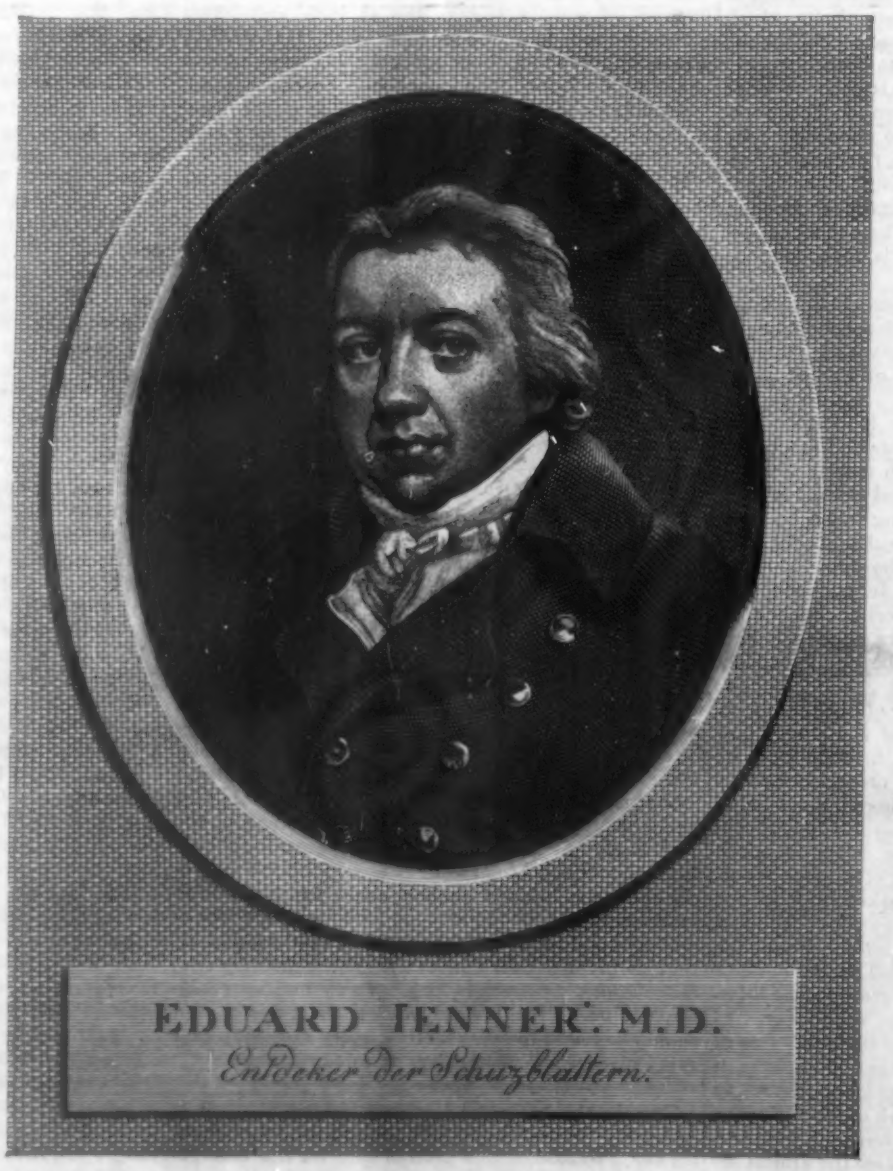
There is probably no greater contrast in the whole history of mankind than this picture presents in comparison with that of smallpox in the countries where vaccination is enforced to-day. In the city of Brooklyn we have gone whole years without seeing a single case, and last year (1895) there were but sixteen cases, with one death, among our million inhabitants, and the present year promises as clean a record.

Dr. Jenner died on the 26th of January, 1823, at the age of seventy-four. The following epitaph is inscribed on his tomb:

"Within this tomb hath found a resting place
The great physician of the human race—
Immortal Jenner! Whose gigantic mind
Brought life and health to more than half mankind.
Let rescued Infancy his worth proclaim,
And lisp out blessings on his honored name;
And radiant Beauty drop one grateful tear,
For Beauty's truest friend lies buried here."

JENNER MEDAL.

METHOD USED IN MAKING THE JENNER MEDAL.



PORTRAIT OF DR. JENNER.

* The prints and medal which we reproduce are from Dr. Hunt's collection of Jenner portraits and medals.—ED.

Color of Uniforms.

Referring to the agitation for the abolishment of the scarlet uniform in England, the Admiralty and Horse Guards Gazette says: "It is so frequently taken for granted that red is the most conspicuous color that could be used for that purpose, that to hear it combated, and with irrefragable arguments, is something of a novelty, even for those who are ready to be convinced in favor of the smarter accouterment. A German officer recently declared that the white coated cuirassiers were more conspicuous even against the snow than the red coats of the Ziether Hussars, and complimented Englishmen on being so practical a race as to embody this fact in the uniform of their soldiers. He further mentioned special experiments on the ranges in corroboration of his statement, the results furnished being three hits to the blue target against one to the red. As a further illustration, a squad of ten volunteers, two dressed in light gray, two in dark gray, two in scarlet, two in dark blue, and two in green, were ordered to march off, and were carefully watched by a number of volunteer officers, and the result attained was as follows: First the light gray disappeared, next the scarlet, then the dark gray, and long after this the dark blue and the dark green were still visible. The importance of these experiments cannot be overrated, and it is to be hoped that they will be followed up until a definite conclusion has been arrived at."

THE railways in France employ 24,080 women, the majority of whom receive a small sum for opening and shutting gates where roads cross the track.

TESTING MOTOCYCLES.

Speed in a motor carriage is desirable, but it is not, however, the first requisite, for general utility and safety are of more real importance than great speed. That this is now recognized is shown by the fact that in the Engineer horseless carriage contest, which will be held in 1896, no speed greater than ten miles an hour will have any weight with the judges. When the Chicago Times-Herald made their offer of $5,000 to be awarded to successful horseless carriages, it was with the earnest desire that the contest should add to the sum of our mechanical knowledge in this branch of transportation. The race of November 28 was not quite as picturesque as those held in France, owing to the fact that the number of contestants was small and the roads were in a very bad condition; but it is probable that this race will really be of more permanent value than those held abroad in the advancement of the art and in the stimulating of American inventors to renewed efforts. It is stated that more than five hundred applications for improvements in motor carriages have been filed in a few months in the Patent Office. The excellent rules which obtained in making the awards were largely responsible for the scientific value of the race. The following rules were adopted:

"1. A preliminary test of all vehicles entered for competition shall be held by the judges under such rules as the judges may determine on, and for such a distance as they may decide. At this test the judges may debar such constructions as in their opinion do not possess features entitling them to further consideration. It is stipulated, however, that all motor vehicles which won prizes or honorable mention in the Paris-Rouen contest of 1894 or in the recent race between Paris and Bordeaux shall not be compelled to compete in the preliminary test, but shall be admitted upon proper application to the final competition.

"2. In making awards, the judges will carefully consider the various points of excellence as displayed by the respective vehicles, and so far as possible select as prize winners those constructions which combine in the highest degree the following features and requisites, rating them of value in the order named:

"3. General utility, ease of control and adaptability to the various forms of work which may be demanded of a vehicle motor. In other words, the construction which is in every way the most practical.

"4. Speed.

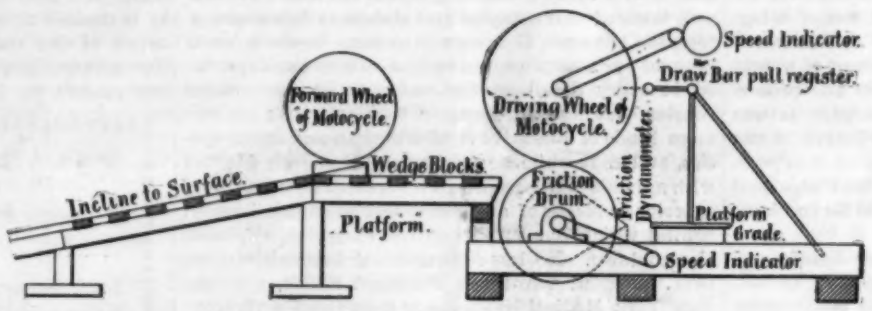
"5. Cost; which includes the original expense of the motor, and its connecting mechanism, and the probable annual item of repairs.

"6 Economy of operation, in which shall be taken into consideration the average cost per mile of the power required at the various speeds which may be developed.

"7. General appearance and excellence of design. While it is desired that competing vehicles present as neat and elegant an appearance as possible, it should be assumed that any skilled carriage maker can surround a practical motor with a beautiful and even luxurious frame."

The tests to which the motocycles were put were of a purely scientific nature, as it was intended to separate the chimerical from the practical machine. By this means positive proof was obtained that the problem of horseless carriages was one that inventors and manufacturers are in a fair way to solve. A complete detailed report of the judges was published in SUPPLEMENTS 1058, 1059 and 1060. To test the motocycle, a very complete testing plant was installed first at Washington Park and later on in a building which had been put at the disposal of the judges by Studebaker Brothers. We give a diagram of the apparatus used and also a view of the testing plant when it was erected at Washington Park. It was designed by Mr. L. L. Summers and Mr. John Lundie. As will be seen by the diagram, the apparatus consisted of two distinct parts, one an absorption brake dynamometer and the other a pull bar or traction dynamometer.

The motocycle was run up the inclined surface and the front wheels were firmly wedged up with blocks. The rear or driving wheels rested on friction drums, as shown in the diagram and illustration. A pulley on the shaft of the friction drum was connected with the lever of the Prony brake, which is a typical form of the absorption dynamometer. It consists of a lever



APPARATUS FOR TESTING MOTOCYCLES.

connected to the revolving shaft in such a manner that the friction induced between the surfaces in contact will tend to rotate the arm in the same direction in which the shaft revolves. This rotation is counterbalanced and weighed by means of a platform scale. The horse power or work of the shaft is determined with the aid of a simple formula from Kent's Pocket Book: Let W equal the work of the shaft which equals the power absorbed per minute, P equal the unbalanced pressure of weight in pounds acting on the lever arm, let L equal length of lever arm in feet from center of shaft, V equal the velocity of a point in feet per minute at a distance equal to the length of the lever arm in feet to the center of the shaft, if the arm were allowed to rotate at the speed of the shaft, and N equal the number of revolutions per minute; from these factors the horse power is easily obtained. $W = PV = 2\pi LNP$. Now, since the horse power (H. P.) $= PV \div 33{,}000$, we have the following formula:

$$H.\ P. = 2\pi LNP \div 33{,}000.$$

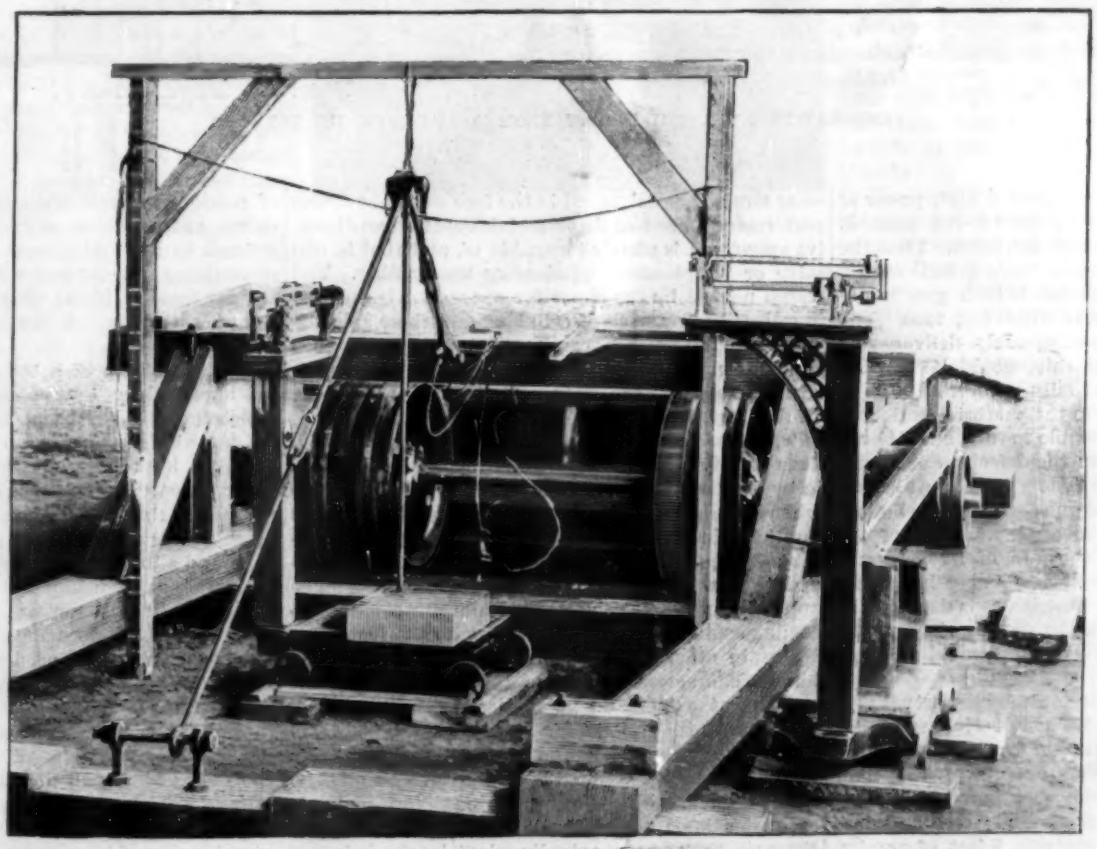
The drawbar pull test made it possible to obtain the power exerted by the vehicle and the tendency it will be able to exert in going ahead, which is technically known as the "drawbar pull." This pull is limited by the traction or friction which exists between the wheel of the vehicle and the surface of the road. The traction varies with the kind of road, and in the tests of the vehicles, roads of all kinds were represented by changing the surface of the revolving drum. The results obtained do not determine the facts alone, but show the relation between the artificial surfaces and the testing machine and the actual road conditions, and thus enable corrections to be applied to all vehicles and enable the determination of their actions on any road to be accurately made. This drawbar pull and the horse power were both measured with the aid of platform scales.

The Morris & Salom electrobat, which received the gold medal, and which we illustrated in the issue of November 16, 1895, was tested as follows:

Tests were made first by ascertaining the internal losses of the motors and gearing and the friction of the wheel surface and bearings. These determinations were made by driving the mechanism from an external source of power and measuring accurately the speed of the vehicle and the pull exerted. It is possible by this method to make a most delicate test of the power developed. In the Morris & Salom vehicle these determinations were thus made, and as the vehicle is driven electrically, when the motor on the vehicle was operated, the power imparted to the motor could also be accurately determined, and the power developed at the wheels, added to that lost in the mechanism, was thus ascertained. As the power developed was measured by means of the dynamometer, adding the losses previously determined gave the same results as those obtained by the electrical method, so that the accuracy of the determinations was thus checked and found to agree identically. That the electrical and mechanical methods should thus agree speaks well for the system of making the determinations, the care of the observers of the instruments and the accuracy of the instruments themselves.

Determinations of the losses between the driving motor and the run of the wheel upon the road surface were thus made. These determinations were made independently of the motor on the vehicle proper, as the testing apparatus had been equipoised with a power driving device which allows very sensitive measurements to be made.

In one of the tests a determination was made of the friction of a ball bearing pneumatic-tired wheel, running on a perfectly level surface. Although there was no load imposed on these wheels, the testing apparatus was so delicate that this determination was made without difficulty, and whenever the hand was placed gently upon the vehicle the effect was instantly apparent upon the dynamometer, which was specially designed for motocycle testing. In all methods of testing vehicles heretofore practiced, the dynamometer measurement has been one of the most difficult determinations to make.



APPARATUS FOR TESTING MOTOCYCLES.

Experiments in Frozen Water.

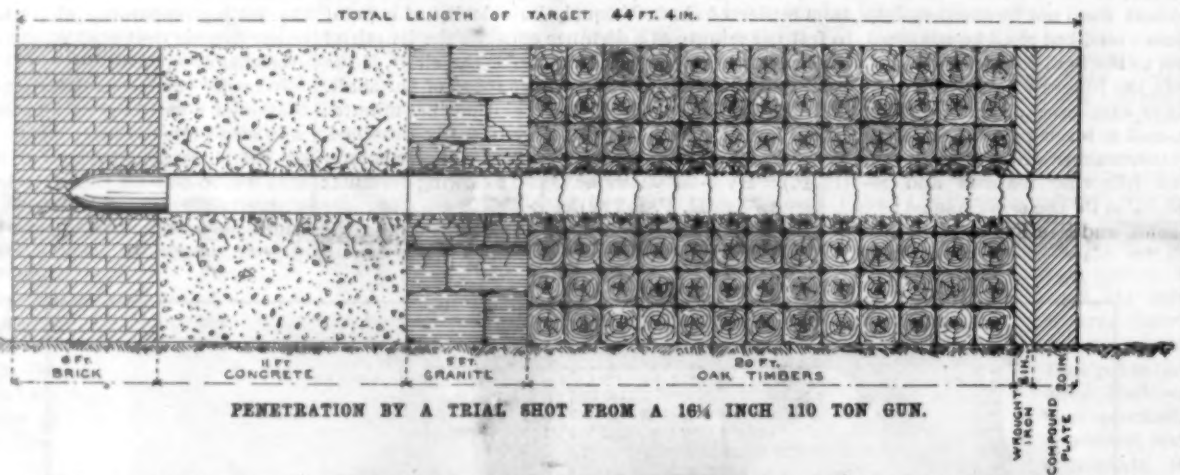
It is quite generally supposed, says Public Opinion, that the sudden and complete freezing of lakes and watercourses must necessarily be fatal to all their inhabitants. Recent experiments by a French scientist, M. P. Regnard, have proved this to be an error. He cooled the water in an aquarium containing live carp to different degrees below freezing. At 0° C. the fishes seemed to fall asleep, but were not frozen. At —3° they were apparently dead, but retained their flexibility. The water being then gradually warmed, they revived, began to swim, and showed no signs of suffering. This would indicate that the polar seas, whose temperature never falls below 3° C., may be a congenial abode for creatures inured to this degree of cold.

ACCORDING to a cable dispatch the Governor of Yakutsk reports officially that the inhabitants of Ust-Yansk have not heard anything about Dr. Nansen, the Arctic explorer, who was recently reported to be returning after having reached the North Pole.

THE PROPOSED SIXTEEN INCH GUN FOR COAST DEFENSE.

With the comparative failure, some years ago, of the 16¼ inch 110 ton guns, and the 17 inch 105 ton guns, respectively mounted in the English and Italian fleets, the manufacture of these monster weapons ceased altogether, and it was predicted at the time that no more of them would be built. The tendency of late years has been to reduce the weight of the main battery, the heaviest guns of the United States battle ships being 63 tons weight; of the English, 46 tons; of the German, 43 tons; and of the French, 44 tons. The reasons which led to the adoption of the lighter guns were the great difficulty of manufacturing guns of over 100 tons weight that would stand the actual test of firing; their destructive racking effect upon the ships in which they were mounted; the large amount of weight which had to be allotted to their mounts and protection; and the slowness of their discharge. It was found, moreover, that by increasing the length of the guns, reducing the caliber, and using smokeless powder, a much greater speed of firing and an equal amount of penetration could be obtained for the same total weight of guns and mounts.

But, while the argument in favor of lighter and more handy guns is a powerful one, as applied to battle ships, it is not so strong as applied to land fortifications. The mounting and protection of a 110 ton gun in an earthwork redoubt would cost far less than it would to place the same gun with similar protection upon a battle ship. The unsteady platform afforded by a ship's deck, combined with the slowness of firing, makes the probability of scoring a hit very remote; but such a gun mounted in a fort and trained across a channel, such as the entrance to New York Bay or San Francisco Harbor, where the ranges are short and accurately known, would have every chance to get home a shot normal to the water line belt armor of a passing ship. One such penetration of the vitals by an 1,800 pound shot would do more to wreck the ship than a continued battering by lighter shot and shell. It is mainly for this latter reason that General Flagler, of the United States army, advocates the building of a certain number of 16 inch guns for coast defense.



PENETRATION BY A TRIAL SHOT FROM A 16¼ INCH 110 TON GUN.

The destructive force of a shot may be expended in penetrating the armor or in racking and crushing in the sides of a ship. While it is true that modern 45 or 50 ton guns have a high power of penetration, they fall far below the 110 ton guns in the crushing force of the blow delivered. Thus the 12 inch 45 ton United States gun has a muzzle energy of 26,000 foot tons, whereas the 16 inch gun would probably develop not less than 60,000 foot tons. The racking effect of such a blow, squarely delivered on the belt armor of a passing ship, would be terribly destructive, even if it should fail to penetrate.

The recent improvements in the material and manufacture of guns make it possible to turn out 110 ton guns that would be free from the defects of the early English and Italian guns. The drooping which occurred at the muzzle of these guns after firing a limited number of rounds was due to the short length of the outer hoops, which robbed the gun of its necessary transverse strength. By employing longer hoops and disposing them to better advantage, as is done in the United States guns, there is no question but what a 110 ton gun could be turned out which would be thoroughly reliable.

The accompanying illustration shows the actual penetration of a target by an 1,813 pound Holtzer projectile, fired from one of the 110 ton guns built for the battle ship Sanspareil. The energy of the blow was 54,320 foot tons, and the shot bored a 16¼ inch hole through 20 inches of compound steel and iron plate, 8 inches of iron, 20 feet of oak, 5 feet of granite, 11 feet of concrete, and finally buried itself in a 6 foot wall of brick masonry.

The shell of a 110 ton gun contains a bursting charge of 187½ pounds of powder, and as it would hurl in all directions nearly a ton of flying fragments, its destructive effect in a boiler or engine room, or in a crowded battery, would be incalculable. Some idea of its effect may be gathered from the havoc wrought at the battle of the Yalu, when a 12 inch 725 pound shell struck the barbette of the Japanese admiral's ship, putting the 66 ton gun out of action, killing 30 and wounding 40 of the crew, besides wrecking all the internal fittings on that deck.

The moral effect of two or three 110 ton guns, mounted at Sandy Hook, New York, or at the Golden Gate, San Francisco, upon an attacking fleet would be well worth the cost of their manufacture; and should a ship attempt to cross their line of fire, it would be at the risk of almost certain disablement.

Our Relations to Plants.

It is natural to have a pretty high opinion of anything that belongs to ourselves. While we have admitted for some time past that some very wonderful processes and things were to be found in the organization of the lower animals and plants, yet we have always had a feeling of conscious pride that the term "fearfully and wonderfully made" applied with special and unique appropriateness to the mechanism of our own bodies. Our complex and elaborate digestive system, for instance, is a case in point. It was a great blow to our amour propre to find that it was deplicated in every detail in the stomachs of our animal cousins, but we still clung to the facts that we had more kinds of digestive ferments than any other species, and that while we might deign to admit kinship with animals in this respect, we were still immeasurably superior to plants of any sort. But even this barrier, behind which our pride has entrenched itself, must also go down. No less distinguished authorities than Prof. Marshall Ward and Pentland Smith, says the New York Medical News, have discovered a vigorous starch-digesting or diastatic process in the grains of the familiar maize and the tubers of the lowly potato. In both cases so soon as the bud or shoot begins to develop it secretes a ferment that attacks the starch of the mass and changes it into sugar for absorption by its growing cells. It is this conversion and rapid absorption of the starch that cause the familiar shrinking and shriveling of potatoes that have sprouted in the cellar. Thus it seems clear that we shall have to "acknowledge the corn" as one of our relatives.

But worse is to follow. Not only can this wretched cereal do with ease what our salivary glands and pancreas strain themselves red in the face over, but it also performs another feat that our elaborate human digestive apparatus is utterly incapable of, and that is, dissolve or "peptonize" cellulose or woody fiber. The starch needed by the shoot for conversion is inclosed in cells with firm walls of cellulose, and these must be eaten through before it can be acted upon by the diastatic ferment. Accordingly another ferment is secreted that dissolves cellulose as our pepsin does proteids. Of the helplessness of our own ferment in the presence of cellulose we have all had personal and painful demonstration in the extraordinary vagaries indulged in by the festive cucumber and the frugal raw turnip when introduced into our unsuspecting and defenseless interior. In fact, the peptonizing power of the vegetable ferment is so much greater than that of the animal that, as we see daily, the papayotin of the pineapple, the pawpaw, and other fruits are rapidly becoming commercial rivals of the porcine product.

Certain other plants display even more strikingly human characteristics in that they have actually become meat eaters and meat digesters. It has long been known that a large family of flowering plants, of which the "Sundew" and "Venus' Flytrap" are familiar examples, secreted upon the surfaces of their leaves a thick, sticky juice, which in the former simply entangles insects, and the latter attracts and holds them till they can be actually seized by the halves of the leaf closing upon them trap fashion. Whether these were utilized in the nutrition of the plant was, however, an open question until quite recently, when a series of analyses of this viscid secretion was made, and it was found to contain both a peptic ferment and an acid, which together rapidly dissolved all the soft tissues of the insects, leaving only the wings and hard cuticular casing of the body and limbs. And what makes the resemblance to our own gastric processes most striking is that neither the acid nor the ferment is present in any quantity in the resting condition of the leaf, but both are poured out as soon as nitrogenous matter is placed upon the surface. Truly our pedigree is of wonderful length, and we must regard ourselves not only as "magnificent animals," but as superb vegetables. If our physiologic processes are so strikingly similar, what a flood of light may vegetable pathology be expected to throw upon our disease processes!

Notice to Our Readers.

In order to obtain the opinion of the readers of the SCIENTIFIC AMERICAN as to what invention *introduced within the last fifty years* has conferred the greatest benefit upon mankind, we publish the accompanying card, which please cut out and return to the editor. Those who preserve the paper for binding and do not desire to deface their files, or who read this notice at a library, will please answer by postal card. It is desired to get as full a vote as possible. The result of the vote will be published in the *Special 50th Anniversary Number of the* SCIENTIFIC AMERICAN *on July 25.*

Editor of the SCIENTIFIC AMERICAN.

Dear Sir:

I consider that.....

.....

invented by.....

has conferred the greatest benefit upon mankind.

Name.....

Address .....

Uses of a Piece of String.

The importance of a piece of twine in an emergency is thus set forth by a writer in the New York Sun:

A piece of string is often of great value to a hunter or fisherman. Stout string, such as is used to tie up heavy bundles, is most valuable. Some sportsmen put a piece of string at a higher value than any other single part of the camp outfit, apart, of course, from the implements of sport.

If the fishing rod breaks, the string mends it again. If the suspenders break, the string ties the ends together. Should the gun stock break, the string is invaluable. If a pack basket strap fails, a string takes its place. A tear in a tent is sewed up with string. Game is hung up out of reach of animals with string. A lost man makes snares out of string and catches birds and rabbits enough to keep him from going hungry; likewise a stout string will serve as a fish line in the absence of regular tackle. If the chain is lost, the dog may be led with a string. A boat can be anchored with a rock and cord.

In the absence of a string a substitute is made by cutting a strip as long as needed from a deer hide off which the hair has been taken. The woodsmen prefer a rawhide string to all others, because it is much stronger, if properly cut, and the woodsman is very expert in cutting the string of even strength. Where the hide is thin he cuts a broad strip; where it is thick he cuts a narrow one. He prefers horsehide to buckskin, and a buck's skin is better than a doe's.

A raft is easily made with a string and three or six logs, according to the size, and many a skin boat is sewed with rawhide strings. With a piece of string in his pocket, no man need starve, or lack for sport, though lost and forty miles from anybody. He can break off a hemlock branch, make a bow, use a slender sapling for an arrow, and shoot his game as the Indians did. If he has a jackknife, so much the better, but the string alone will do. Fire may be started in an unraveled string by striking sparks into it from two hard rocks. A very important use of a string is stopping the flow of blood from a wound. A strip of bark, with a round stone to press into the artery, and a string to tie tight over the bark, has saved many lives, and will save more. The strip of bark prevents the string from cutting the flesh. In case of a broken leg, a bark sheaf and a string keep the bones in place.

"A STRIKING illustration of the influence of fatigue upon the nervous system," says Modern Medicine, "is afforded by an experiment conducted by an Italian physician some months ago. Twenty-four bicycle riders who had ridden thirty-two miles in two hours and a quarter were examined with reference to their hearing, and it was in nearly every instance found to be defective. After two hours' rest the hearing had become normal in most of them."

HAILSTONES OF GREAT SIZE.

We publish herewith an engraving taken from a photograph which was kindly furnished us by Mr. Frank Minter, of Corning, Kansas, which shows a wonderful fall of hailstones which occurred on the afternoon of May 8, at that place. Mr. Minter says the pan of hailstones was scooped up promiscuously half an hour after the storm, and in order to show the great size of the specimens, he has placed alongside of the pan an ordinary sized hen's egg, while in the pan are some potatoes. Mr. Minter says, "We have often heard of hailstones as large as hen's eggs, but these are considerably larger. When the photograph was taken they were a good deal smaller than when they fell. Some were found that measured thirteen inches at their greatest circumference. The roar of the approaching storm could be heard for fully a quarter of an hour before its arrival. Scarcely any damage was done, except to chickens and wild birds, and no less than sixty dead birds were counted along one mile of hedge."

Telegraphing Around the Globe.

CHAUNCEY M. DEPEW'S ADDRESS AT THE NATIONAL ELECTRICAL EXPOSITION.

On Saturday evening, the 16th inst., at the Grand Central Palace, of this city, a successful attempt was made to utilize the electricity generated at Niagara Falls for sending a message around the world and back, arrangements having been made in advance with the several companies, and it was a very remarkable feat illustrating the excellent telegraphic facilities now provided.

It was arranged that Mr. Chauncey M. Depew should send one dispatch, which after passing over the globe and back should be received by Thomas A. Edison in another part of the hall, and at the same time Mr. Edward D. Adams, of the Niagara Power Company, should send a reply to Mr. Depew over the whole globe and back from the box occupied by Mr. Edison in opposite end of the hall.

At 8:34 o'clock Mr. Depew handed the following message to A. B. Chandler, the president of the Postal Telegraph Company: "God creates, nature treasures, science utilizes electric power for the grandeur of nations and the peace of the world." The exact moment of the sending of the message on its journey around the earth was announced by the firing of cannon on the roof of the building. In its transit it first traveled via Chicago, Los Angeles, and San Francisco to Vancouver. From the latter place it was sent through Canada by way of Winnipeg, Montreal and Canso and then cabled to London, from where it was continued to Lisbon, Gibraltar, through Malta, Alexandria, Suez and Bombay, to Madras, and thence via Singapore, Shanghai and Nagasaki to Tokio, from which center it was sent back by the same lines to London and to America. The message was received back in Mr. Adams' box, at the Grand Central Palace, by Thomas A. Edison at 9:21½, having occupied an elapsed time of just forty-seven and one-half minutes.

Four minutes after the dispatch of the message, Mr. Adams forwarded an answer to Mr. Depew along the Western Union wires over the same route, which read: "Mighty Niagara, nature's wonder, serving man, through the world's electric circuit proclaims to all peoples science triumphant and the benevolent Creator." The time of transit of this message was exactly the same as in the previous case, the distance over which each one was sent being 27,500 miles. The same telegrams were also sent to Galveston, Tex., to Mexico, right around the South American continent, then to Lisbon and London and back again to New York, and the distance which it covered of about 10,000 miles was traversed in twenty-one minutes. The receipt of the messages at the various centers was signaled to the people in the exhibition by the firing of the cannon, and each report was met with a hearty outburst of cheering.

While the messages were being transmitted, Mr. Depew entertained the audience with a brief review of the world's progress, especially as it concerned the development of the use of electricity. Among other things he said:

"The rise, the rule for thousands of years and the fall of Rome are condensed in a few volumes upon the shelves of the libraries. These events covered unnumbered centuries, and yet in the humanization, the elevation, the civilization and the happiness of the people of the earth they did little compared with the accomplishments of inventive genius during these four marvelous decades. The electric telegraph in 1845, the cable in 1856, and the telephone in 1876 are part of the victories. We can only measure the results of these inventions by estimating their influence upon commerce, transportation and the material development of nations and the effect upon governments and peoples of instantaneous communication with each other. Thirty years ago there were 75,000 miles of wire in the United States; to-day there are 1,000,000 miles. Thirty years ago 5,000,000 messages were annually transmitted by telegraph; now there are 60,000,000. In a quarter of a century the receipts of the telegraph companies have increased from $7,000,000 to $25,000,000 per year. Since the opening of the telegraph the imports and exports of the United States have grown from $220,000,000 to $1,600,000,000, while the internal commerce of the country has grown from about $1,000,000,000 to the fabulous figure of $25,000,000,000 a year.

Said the great English scientist, Sir William Thomson, at our Centennial Exposition in 1876, after he had examined the telephone: "What yesterday I should have declared impossible, I have to-day seen realized." In twenty years the use of the telephone has become such a necessity in our daily life that the mileage of the telephonic wires had increased to 600,000 miles and the number of telephones to 700,000. Nothing more distinctly illustrates the truth of the charge that the Americans are a talking people than the statistics of this wonderful instrument, for during the last year there were had over the telephone wires of the United States alone 670,000,000 conversations. And yet the telephone is only partially developed.

Time will permit only a brief suggestion of the rapid introduction of electricity into every department of industry. It furnishes power for the mill and the machine shop; it is the motor for the railway carriage; it heats and it cools; it forges and it welds, and it extracts from the most stubborn ores ordinary minerals and precious metals. In our practical age the dividing line between the scientific toy and profitable power is the cost of production. The price of coal limits the possibilities of settlement and the growth of cities. Industries and their development are dependent upon steam and electricity, and the generation of these forces upon coal. The most superb agricultural opportunities of the world are upon the Pacific coast, but the varied industries necessary for the support of a large population do not thrive there, because the black diamond has not been discovered in the Sierra Nevada or the Sierra Madre.

WONDERFUL FALL OF HAILSTONES.

This exposition illustrates another beneficent advance in electrical development. It suggests an opportunity to escape from territorial limitations of coal and the prohibitive cost of transportation. Wherever there are mountains and lakes there is water power. That this power can generate electricity has been known, but its usefulness has been handicapped because the mill and factory could not be readily transplanted. The most sublime concentration of continuing force in the world is Niagara Falls. After the unveiling of the Statue of Liberty Enlightening the World, which had been presented to us by the French republic, I took the representatives of the French government to Niagara Falls. When they saw it their feelings were aptly expressed by Admiral Jouett, who exclaimed with dramatic earnestness, "I have seen all the natural wonders of the globe and this surpasses them all. If there shall ever be an exhibition of the universe when the stars and planets contribute their best, the earth will send Niagara Falls.

We are here, 450 miles from Niagara, and witnessing that the power generated there can be transmitted here. It is a demonstration of incalculable value. It will redeem the waste places of the world. The tumbling torrent will become the treasure house of nations. Wherever water flows electrical power may be generated, which, transmitted great distances, will create the mill, the factory and the furnace, and give that employment to capital and labor which relieves the farmhouse of its surplus of boys and girls and gives the farm its profitable market in a neighboring seat of population and industry.

The next feat of electricity, now almost accomplished, is to be its use in transportation. It is to accelerate the speed and increase the comfort of the passenger train and to reduce the cost for the revolving wheels of the freight car; it is to be largely the substitute for the horse, for agriculture and the road wagon; it is to furnish the light for dwelling and factory, for hospital and highway; it is to give the heat for cooking and for comfort; it is to be the power for the machinery of the mill and the press of the newspaper; it is to be the motor for transportation by land and sea."

Steel Roads.

The latest suggestion for an improved form of roadway comes from Mr. Budd, the commissioner of public roads of New Jersey. In his report to the governor Mr. Budd recommends that steel be used in the construction of roads both in town and in country. Some of the best authorities have predicted that the coming material for highways will be steel, but just exactly how it is to be used they did not say. In Mr. Budd's plan broad steel rails are to be placed for the accommodation of traffic where the travel is greatest, while the remainder of the road can be made of granite or wood.

The average cost of a macadamized road 16 feet wide is about $7,000 a mile. The cost of a double track steel road 16 feet wide, filled in with broken stone, macadam size, the commissioner puts at $6,000 a mile. A one track road would only cost $2,000 a mile. The rails, which are really flat plates of metal, are made of steel the thickness of an ordinary boiler plate, gutter shaped, five inches or more wide, with a square perpendicular shoulder half an inch high, and then an angle of one inch ortward, slightly raised, thus forming a conduit for the water and rendering it easy for the wheels to leave or enter the track.

The advantages claimed for the metal road are: First, great durability; second, a horse can draw on a steel track twenty times as much as on a dirt road and five times as much as on the best macadam.

The tracks would really be very much like a horse car track, were it not for their much greater breadth and the slight, sloping rib instead of the high rib of the street car track. There would be no wrenching of wheels and bending of axles, such as a car track often causes, and the wheels would roll on and off the steel track or plate with the greatest ease. Another feature in the steel rail idea is the absence of jolting, which ruins the wagon.

The principal point, however, which would be gained is the great durability of the steel road. Even the hardest granite is rapidly worn down. Holes and ruts form, and once formed, rapidly become larger, until costly repairs are necessary to make travel even possible. The steel tracks would be cheap, easily renewed and almost everlasting, while the material between them need only be some cheap roadmaking soil. The rails would take up all the wear and the soil between would furnish good drainage. Other tracks nearer the curb might be added for the accommodation of bicyclists, who would not then be jolted nearly to death, as they are in going over uneven granite blocks.

The steel track idea is not entirely new. On many bridges broad steel plates have been laid along that part of the road where travel is greatest. The curbs of the bridges in London are lined with steel to prevent the grinding away of the stone by cart wheels. Steel roadways would work wonders in regulating street traffic.

For city purposes the steel road would have to be laid with great solidity. The latest pavements of Belgium blocks in New York are more solidly constructed than any other kind of road, but it is hard work to keep them level. On Broadway blocks of the best Maine granite resting on solid concrete a foot thick are firmly bound together by sharp road sand and asphalt. In the steel road the tracks would be laid on cross ties of steel, with all interstices filled in by concrete and water proof cement.—The Northeastern Lumberman.

Brooklyn Bridge Electrical Equipment.

The trustees of the Brooklyn Bridge have made provision for the expenditure of $100,000 for new electrical equipment. Two Babcock & Wilcox boilers, of 400 horse power each, two 600 horse power engines by the Southwark Foundry and Machine Company, and two Walker generators will constitute the power and light plant. Twenty cars, 48 feet long, equipped with electric motors, will be furnished by the Pullman Car Company. The trustees estimate that, by installing their own plant, they will save $55,000 yearly to the two cities. The improved terminal switching facilities, coupled with the new electric equipment, will enable the headway to be reduced to one minute.

Method of Silvering Mirrors.

A curious method of silvering mirrors has recently been patented by M. Hans Boas, of Kiel (says Engineering). It is based upon the fact that, when one of the heavy metals forms the cathode of a vacuum tube, containing a trace of hydrogen, the metal is volatilized by the current, and is deposited as a firmly adherent and highly polished layer on the walls of the tube. The mirror thus produced is said to be of much greater brilliancy than can be obtained by ordinary methods.

RECENTLY PATENTED INVENTIONS.

Mechanical.

SHINGLE EDGER.—Harvey G. Richardson, Tacoma, Washington. This invention provides a new and improved shingle edger, which is simple and durable and which is arranged for cutting the shingles accurately to any desired width, and without danger of the operator being liable to be injured by the saws. The invention consists principally of a feed carriage for feeding the shingles to the saws, and rollers for drawing the shingles through the saws after the feed frame is at the end of its inward movement.

ADJUSTABLE FOOT REST.—Rufus D. Brown, Gardner, Mass. This invention is intended to provide a new foot rest for general use in rooms, preferably, however, in connection with a hot air register or other heating medium, and it is so constructed to enable the user to readily change the position of the foot rest as desired. For this purpose the foot shelf or platform is provided with arms in which the shelf is mounted to turn, the arms being connected with each other and adapted to be engaged by a hook fastened on a transverse shaft carrying a treadle under the control of the operator.

BABY JUMPER.—John Elbert Ring, Chatham, N. Y. The object of this invention is to provide a spring support for cradles, adapted to be applied to a floor or the tread of a stoop, etc. It is so arranged that, when the child makes the least movement, it will give the cradle a vertical and side movement. It consists of a pole provided with a fastening device at the heel, a fixed fulcrum adjacent to the heel, and a baby carrier or cradle suspended from the free end of the pole. The pole is reinforced by an adjustable, flexible rod, capable of bending throughout its length. The construction of both the cradle and support is simple, durable and economic.

Miscellaneous.

CLOCK CASE.—Adam Schieffer, New York City. The object of this invention is to provide a case for cheap clocks, as the ordinary nickel alarm clock. It consists of an ornamental front which masks all the clock except the dial. The clock is placed in the case from the back, and is secured by flat metal clips mounted pivotally. When mounted in the case, the winding and setting arrangements are not disturbed.

BICYCLE SKIRT.—Jacob Berlfein, New York City, and Henry Diamond, Brooklyn, N. Y. This improvement consists of a bicycle habit for ladies which is attractive in character and which is so constructed as to afford free movement to the limbs of the wearer. It comprises trousers and a divided skirt within which the trousers are secured. The skirt is provided at the divided portion with vertically disposed plaits or folds, the lower portions of the skirt, at each side, being provided with a strap and buckle. With the aid of the straps and buckles, the back breadths of the skirt can be drawn forward to prevent the folds or plaits from catching in the machine.

POTTERY WARE STOVE.—Julius Salomon, Berlin, Germany. This invention is an improvement in pottery ware domestic stoves. It consists of a single piece, so that it can be transported without being taken apart. It is a stove having an outer shell integral from end to end, a fire chamber and inner longitudinal passages or flues, also made integral from end to end and extended downward below the fire chamber.

VALVE STOPPER FOR BOTTLES.—John Bazant, Jr., New York City. The object of this invention is to provide a bottle which cannot be refilled. It comprises an outer shell having its upper end turned inward and provided with an outlet opening, a valve casing in the outer shell having a valve opening in its lower end and having perforations in its wall, a ball valve in the casing and a movable closure in the upper end of the valve casing, the said closure being of greater diameter than the opening through the outer shell, and having a thickness greater than the space between the upper end of the valve casing and the upper end wall of the outer casing, so that the closure cannot be wholly withdrawn from the valve casing.

PLACKET FASTENER.—James Determan, Brooklyn, N. Y. This placket fastener comprises two stays arranged to have movement in the same plane, and a fastening device the members of which are carried respectively by the stays and project from the inner edges thereof toward each other, the members engaging by a movement of the stays toward each other and in the plane of the stays and disengaging by the movement of the stays away from each other, the object being to facilitate the engagement and disengagement of the fastener.

Designs.

DESIGN FOR CARPET.—Eugene Crowe, Brooklyn, N. Y. The body and border also, if one is used, are decorated with floral figures, each figure comprising foliate sprays grouped together and bent upon the lines of a compound curve, and a rose is placed at each side of the foliate sprays, the upper portion of the foliate sprays at each side falling gracefully upward above the upper portions of the side sprays.

DESIGN FOR CARPET.—Eugene Crowe, Brooklyn, N. Y. The body and border, if one is used, are decorated with composite scrolls the component parts of which are a panel scroll figure, a lower curved foliated figure connected therewith, a second foliated figure continuing the curve of the lower figure, and a third foliated figure which extends from the second corresponding figure and is curled in the space between the panel scroll and the intermediate foliated figure.

DESIGN FOR CARPET.—Eugene Crowe, Brooklyn, N. Y. The body and the border also, if one is used, is decorated with linear foliated scrolls. In detail each linear scroll figure comprises an arched foliated scroll having one end carried well down below the body and returned upon itself to present a folded leaf, the folded leaf having floral decorations, as has likewise the body portion of the scroll. The design is too elaborate to permit of intelligent description without an engraving.

DESIGN FOR A DRAUGHTING INSTRUMENT.—Frank O. Tappan and Lillian A. Eggleston, Toledo, O. The leading feature of this design consists in the elongated body carved and broadened at one end and having a straight member projecting from the body inward from said carved end and at the side toward which the end curves.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

YE THOROUGHBRED. By Novus Homo. Three interviews: I. Man as an Animal. II. Man as a Magnetic Battery and an Electro-Telegraphic Machine. III. Man Americanized. The Great Republic, its Status, Dangers, Duties, and its Future. New York: The Health Culture Company. 1896. Pp. 129. Price, paper 50 cents, cloth $1.

HOME CARPENTRY FOR HANDY MEN. A book of practical instruction in all kinds of constructive and decorative work in wood that can be done by the amateur in house, garden and farmstead. By Francis Chilton-Young. With upward of 550 illustrations from the pen and pencil of the author. London, New York, and Melbourne: Ward, Lock & Bowden, Limited. 1895. Pp. vii, 772. Price $3.

This very handsomely made book we feel deserves to be highly recommended to our readers. In its nearly 800 pages, as may be imagined, about everything in this line must receive some attention. Accordingly we find its subject matter treated from the standpoint of the house, the garden and the farm, each division covering very fully the different lines of work which may there arise. It is very elaborately illustrated and by no means the least interesting part of it will be found in the presentation of English tools, it being, of course, written from the English standpoint. Thus, we find shown an English hammer without the claws, while, for drawing nails, we find presented a picture of a pair of pincers, although the claw hammer is described as having "a forked or claw-formed head which renders it useful to gardeners for taking nails out of a garden wall."

MENUISERIE. Avec 132 figures dessinées par l'auteur. Paris: Librairie J. B. Bailliere et Fils. 1896. Pp. 376. Price $1.

What we have said about the preceding work applies largely to the present one if the word "French" be substituted for "English," for in the present book we have an excellent review of carpentry from the Continental standpoint. It is to be regretted to a certain extent that the tools of carpentry do not receive fuller treatment. An especially interesting section, and one which will be of considerable value in manual training schools, is that devoted to wood joints, in which are given dovetailing and mortising of the most curious and ingenious descriptions. The work, very properly, is assumed to be for the many who understand tools, yet want to know what to do with them; which, after all, is perhaps the better and most practical treatment of the subject.

A DICTIONARY OF CHEMICAL SOLUBILITIES, INORGANIC. By Arthur Messinger Comey. London and New York: Macmillan & Company. 1896. Pp. xx, 515. Price $5.

On opening this book it has a familiar appearance to an old time chemist. Its two column pages with full faced type headings of the different paragraphs and titles remind one of Storer's Dictionary of Solubilities. It is, indeed, a successor to that famous work, and in many ways shows the features thereof; but the present volume is restricted to inorganic substances. To all who know Storer it is needless to recommend the book in any other terms than by saying it is a worthy successor to the old author. To those who do not know Storer we can simply say that the book will be found an indispensable adjunct to their chemical library. The author seems to have taken much pains with the work. Merely as a repertoire of formulæ it is exceedingly valuable, and the fact that it has been brought up to a recent date, March, 1896, gives it high value. It is the first book of the kind published since Storer's work, thirty-six years ago.

JOHNSTON'S ELECTRICAL AND STREET RAILWAY DIRECTORY FOR 1896. Containing lists of electric light central stations, isolated plants, mining plants, street railways (electric, horse and cable), telegraph companies, district messenger companies, telephone companies, manufacturers of and dealers in electrical and street railway apparatus, machinery and supplies. New York: The W. J. Johnston Company. Pp. 838.

This is a very complete directory, whose general purposes are disclosed on its title page, which we have quoted in full. To those doing business in electrical supplies or to those requiring electrical supplies the book will be of very considerable value, and we have no doubt there will be a large demand for it from the growing world of those interested in electrical industries.

A POSTAL DICTIONARY. Being an alphabetical hand book of postal rates, laws, and regulations, for all who use the mails. Eighth edition. 1896. Buffalo, N. Y.: The Matthews-Northrup Company. Pp. 102. Price 15 cents.

This excellent little work presents in very compact shape a concise statement of postal matters such as the everyday mortal needs to know. It is arranged in alphabetical form, and is therefore adapted for quick and accurate reference. Its size is supposed to adapt it for the pigeon hole of a desk, and it will find a home in many such a receptacle.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(6859) W. R. G. says: Will you please give me the formula for rendering phosphorus in such a condition that it can be applied to a surface with the aid of a brush, so that it can be seen in the dark? A. Phosphureted oil is the best means of exhibiting the luminous properties of phosphorus. A small piece of dry phosphorus, about the size of a pea, is placed in a test tube with a little pure olive oil. The test tube is held in the water bath until the oil becomes heated and the phosphorus liquefies; it is then shaken until the oil will take up no more phosphorus, and after allowing the oil to become clear, it is poured off into a small glass vial provided with a glass stopper. Only a small quantity of this oil in the bottom of the vial is necessary. When it is shaken about so as to coat the sides of the vessel, and the stopper is removed so as to let the air get in, the oil coated sides of the glass become at once luminous, and continue so as long as the stopper remains out. Characters written on paper with oil thus prepared (freshly) appear in the dark very brightly. Phosphureted ether is prepared by digesting phosphorus in ether for some days in a tightly stoppered bottle. A piece of sugar dipped into this ethereal solution and then thrown into water makes the surface of the latter appear quite luminous in the dark. Young experimenters must remember that phosphorus is very dangerous to handle when out of water, and often inflames spontaneously when exposed dry in the air.

(6860) E. I. N. says: Will you please give me a recipe for making tableting glue for putting up tablets of paper and a recipe for making mucilage? The same will be appreciated by your subscriber. A. Tablet glue.—For 50 lb. of the best glue (dry) take 9 lb. glycerine. Soak the glue for ten minutes and heat to solution and add the glycerine; if too thick, add water. Color with aniline. Mucilage.—A strong aqueous solution of reasonably pure dextrine (British gum) forms a most adhesive and cheap mucilage. Alcohol, or rather diluted wine spirit, is usually employed as the solvent where the mucilage is to be used for gumming envelopes, postage stamps, etc., in order to facilitate the drying, and acetic acid is added to increase the mobility of the fluid. The strong aqueous solution is more adhesive than that prepared with alcohol, for the reason that it contains a greater proportion of the gum. To prepare this, add an excess of powdered dextrine to boiling water, stir for a moment or two, allow to cool and settle, and strain the liquid through a fine cloth. The addition of a little powdered sugar increases the glossiness of the dried gum, without interfering greatly with its adhesiveness. The sugar should be dissolved in the water before the dextrine is added.

(6861) W. K. W. asks: 1. There is a mill being wired here for incandescent lighting. They are going to use 125 volts at switchboard, and 115 volt lamps, and are going to allow for a 10 volt drop. The lamps are 20 candle power. I would like to know if, where the drop is greatest, or 10 volts, if those lamps are going to take more current than they would near the dynamo, where the voltage is higher. If so, how much more current? A. The lamps will need more current for lower voltage in inverse ratio. 2. In a plant where there are five dynamos of 300 amperes apiece, why don't they use say one or may be two machines of greater capacity, instead of more machines? A. It is good practice to have plenty of duplication. Otherwise a single machine would do the work. 3. Can a dynamo of 110 volts and 300 amperes be made to deliver more current by reducing voltage by running slower? A. No. It needs rewinding. As the speed is reduced the output of current is less. 4. In a divided circuit how much current goes by each branch? A. In divided or branch circuits the current in each branch varies inversely as the resistance. See Sloane's "Arithmetic of Electricity," $1 by mail. Thus for 3, 5, 10, 11, and 12 ohm branches with 65 amperes approximately 27,16, 8, 7½, 6¾ amperes would be passed respectively.

(6862) C. S. B. says: I desire to obtain a formula for the preparation of a copying ink which will copy on the ordinary copying tissue without the aid of water or letter press. It is called the dry process of copying.

A. 1. Black:

Nigrosine C. P. fine	10 oz.
Glucose A	1¾ "
Hot water	1¾ pt.
Glycerine	1¾ oz.

Dissolve the nigrosine by trituration in the hot water, then add the other ingredients and strain through a piece of silk. If too thick when cold, dilute to the proper consistence with water.

2. Blue:

Cotton blue (aniline) C. B.	6 oz.
Glucose A	1 "
Glycerine	¼ "
Hot water	2 pt.

Proceed as directed for black ink (above). In preparing these inks it is essential that the water should be kept quite hot while the operation of trituration is performed. The trituration should be continued until all of the dye has been taken up by the water. The straining must be performed hot, otherwise the filtering cloths quickly become clogged. In purchasing nigrosine and aniline blue, obtain, if possible, the purest quality. Cheap grades of these dyes are almost invariably heavily adulterated with dextrine.

(6863) L. N. says: Will you kindly give me directions in the earliest possible issue of the SCIENTIFIC AMERICAN for taking the gloss from photographs, so that I may obtain a good surface to paint on? A. Mount the print in the ordinary way, avoiding lumps. Roll, and afterward sift on the surface finely ground pumice powder. With a circular motion rub gently with the palm of the hand. Proceed until the surface desired is obtained. The use of plain paper is recommended.

(6864) J. E. W. asks: 1. In case a telephone grounded circuit is struck by lightning or becomes crossed with an electric light wire, will the current always take the nearest way to the ground? A. It will tend to take all paths to ground, of both high and low resistance. 2. What is the composition used for fusible wire and plugs in electric work? A. Lead, zinc, tin or fusible alloy may be used. 3. How can two or more electric bells be put on one circuit and be made to ring reliably? A. Use enough battery to do the work or a powerful enough magneto. 4. In telephone construction for exchange work, where the lines do not exceed one mile in length in metallic circuits, is there any advantage to be gained in the transposition of the lines, as is done on long distance circuits? A. It may be highly advantageous, depending on the nearness of interfering circuits.

(6865) A. F. O. asks: Can I charge my storage battery by the commercial street current (direct), voltage 220, with rheostat that gives 10 amperes? There are 5 cells of 2 volts each. Should I connect directly with street wires or interpose the resistance? How shall I know when to stop? A. The process will be uneconomical. Use a rheostat to cut down the current to 5 amperes per square foot of positive plate. Stop charging when gas evolves or when the specific gravity of the solution has reached the standard at which you work.

(6866) J. F. P. asks: Will you give me a prescription and the directions through Notes and Queries (or by mail) for making the jelly for a hektograph? A. An illustrated article on this subject is given in our SUPPLEMENT, No. 438, to which we refer you. You will find a fuller tested formula in our Cyclopedia of Receipts, Notes and Queries. Price $5.

(6867) S. A. S. asks: In a given amount of air how many degrees of heat are consumed before the air reaches its maximum expansion, and how much has the volume of air increased? A. There is no known limit to the expansion of air. It increases in volume 1-273 part of its volume at 0° C. for each degree C. rise in temperature.

(6868) W. T. H. asks: I have a boat built on the plan of St. Lawrence River skiff, 18 feet long, pointed at both ends, 25 inches deep at bow and stern and 16 inches amidships. In center of boat is a seat and immediately in front of this seat is the center board, 32 inches long, projecting into the water fan shape, like a folding board. I wish to use a sail on this boat, and would like to know where it should be placed, assuming I use a 100 foot sprit sail. A. The location of the sail is largely fixed by "good practice." Its center of resistance, depending on its shape, should be a little aft of the center of the centerboard. By trimming your boat by the bow or stern you can make her carry any helm you wish when on a wind.

(6869) T. F. asks: What will harden resin and Venice turpentine, so that they can be softened with steam again? I want to use them for putty for picture frames. A. 1. Dissolve 1 pound of glue in 1 gallon of water; in another kettle boil together 2 pounds of resin, 1 gill of Venice turpentine, and 1 pint linseed oil; mix all together in one kettle, and continue to boil and stir them together until the water has evaporated from the other ingredients; then add finely pulverized whiting till the mass is brought to the consistence of soft putty. This

composition is hard when cold, but when warmed can be moulded to any shape. 2. Mix 14 pounds of glue, 7 pounds resin, ½ pound pitch, 2½ pints linseed oil, 5 pints of water, more or less according to the quantity required. Boil the whole together, well stirring until dissolved, add as much whiting as will render it of a hard consistency, then press it into a mould which has been previously oiled with sweet oil. No more should be mixed than can be used before it becomes sensibly hard. Gold size is then put on, several coats being considered necessar then the gold leaf itself, which is burnished in course of time, and finally covered with finishing size.

(6870) E. G. P. says: Will you please let me know through your Notes and Queries column the farthest distance projectiles have been thrown from the large guns now in use? A. The longest distance that a shot has been fired is a few yards over 15 miles, which was the range of Krupp's well known monster 130 ton steel gun, firing a shot weighing 2,600 pounds. The 111 ton Armstrong gun has an extreme range of 14 miles, firing a shot weighing 1,800 pounds, and requiring 900 pounds of powder. These guns, however, proved too expensive, being unable to stand firing 100 times, and their manufacture has practically been abandoned. The 22 ton Armstrong gun hurls a solid shot for a distance of 12 miles, and the discharge of the gun cannot be heard at the place where the ball strikes. From 12 to 13 miles is the computed range of the most powerful guns now made, and to obtain that range an elevation of nearly 45 degrees is found to be necessary. Quick-firing guns are more depended upon at the present day than extreme length of range, and in this respect what is considered the most wonderful of guns, perhaps, is one of the Maxims, which can fire as many as 600 shots a minute, and yet is so light that a soldier can carry it strapped to his back.

(6871) E. D. J. says: As I am a reader of your valuable paper I would like to ask you if you can tell me what I can clean my white hat with. It is straw. A. Sprinkle with water and expose to the fumes of burning sulphur in a tight box. Or to renovate white straw hats the following method has been recommended. Prepare two solutions as given:

1. Sodium hyposulphite	G.	10
Glycerine	"	5
Alcohol	"	10
Water	"	75
2. Citric acid	G.	2
Alcohol	"	10
Water	"	90

First sponge the straw hat with solution No. 1, and lay aside in a moist room (cellar) for twenty-four hours; then apply solution No. 2, and treat similarly as before. Finally the hat should be gone over with a flatiron, not too hot. If very dirty, the hat must be cleaned with some detergent and dried before beginning the bleaching operation.

TO INVENTORS.

An experience of nearly fifty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

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May 19, 1896,

AND EACH BEARING THAT DATE

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Mattress, ventilated, P. Forsberg 560,613
Measuring instrument, electric, E. Thomson 560,379
Melting furnace, reverbatory, A. N. Gaylord 560,406
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Metal refining apparatus, W. A. Koneman 560,414
Metal working tool, T. L. Stewart 560,239
Metallic articles for electrolysis, manufacture of, M. Perreur-Lloyd 560,533
Mill. See Rolling mill.
Mining machine, E. S. McKinlay 560,263
Mixing machine, Day & Krumholz 560,239
Moulding machine, J. A. Field 560,404
Moulding machine, founder's, F. J. Scott 560,433, 560,548
Mop wringer, A. M. Burnham 560,189
Motor. See Electric motor. Power motor. Rotary motor. Water motors.
Mower, lawn, S. W. Martin 560,514
Music box damping device, H. Langfeider 560,415
Music rack for musical instrument cases, J. A. Weser 560,348
Musical instrument, automatic, A. Richter 560,286
Musical instruments, note sheet for mechanical, A. Richter 560,540
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Neckwear, etc., length adjusting device for, F. O. Ward 560,308
Net making machine, M. Woschyllo 560,560
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Nut wrench, axle, Bourn & Haie 560,339
Oils, refining petroleum or hydrocarbon, F. Berg 560,463
Ordering device, household, F. Kees 560,505
Ore concentrator, C. E. Seymour 560,435
Ore concentrator, Tobey & Thayer 560,589
Ores, process of and apparatus for roasting, W. A. Koneman 560,412
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Pen extractor, A. A. Dayton 560,611
Penholder, J. W. Keeler 560,553
Pencil sharpener, P. E. Sallo 560,304
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Photographs, apparatus for exhibiting successive, A. N. Petit 560,425
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Pianoforte, J. A. Weser 560,347, 560,349
Piano, vertical grand, Schimmel & Nelson 560,453
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Pillow holder, A. L. B. McNair 560,422
Pipe. See Locomotive blast pipe.
Pipe wrench, K. A. Klose 560,220
Pipes and bolts, manufacture of thread protectors for, J. M. Davidson 560,610
Planters, dropping and marking attachment for corn, G. Hanke et al 560,581
Plaster supporting strip or lath, corner, F. L. Union 560,605
Plow, T. M. Bowers 560,466
Pocket recorder, T. H. Gamble 560,304, 560,305
Polar relay, T. E. Dixon 560,313
Post. See Hitching post.
Potato digger, J. D. Wilcox 560,555
Power motor, E. Levings 560,222
Power transmitting apparatus, F. H. Perry 560,229
Press. See Filter press.
Printing machine offset mechanism, C. P. Cottrell 560,345
Profiling machine, Davis & Grobmann 560,347
Pulverizing machine, O. B. Peck 560,638, 560,639
Pump regulator, windmill, H. Tredo 560,243
Pump, vacuum, W. H. Sumbling 560,240
Pumping apparatus, M. Burt 560,190
Pumping engine, steam, A. Campbell 560,608
Punch, W. Mason 560,515
Puzzle, W. E. sharp 560,306
Puzzle, educational, T. B. Elker 560,485
Rack. See Music rack.
Rack for holding drinking glasses, A. Voege 560,447
Radiator, hot water, Canon & Moorehead 560,267
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Railway system, electric, D. M. Therrell 560,551
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Railways, current collecting device for electric, Chapman & Davies 560,472
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Razor, safety, R. E. Gibbs 560,493
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Rheostat, shunt circuit water, J. Buchel 560,340
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Rotary engine, S. S. Fertig 560,314
Rotary engine, I. N. Forrester 560,579
Rotary engine, B. A. Legg 560,221
Rotary engine, H. Ritter 560,303
Rotary motor, J. E. Crisp 560,194
Rubber or the like, machine for corrugating sheets of, Parker & Sutton 560,365
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Sash holder, E. E. Hull 560,356
Satchel, lunch, Butts & Griggs 560,469
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Saw filing machine, H. W. Bertram 560,464
Scissors or shears, J. F. Shultz 560,297
Screen. See Vehicle screen. Window screen.
Screw, worm, J. M. Rauhoff 560,281
Seals, numbering stamp for car, Edgar & Sebring 560,349
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Seed delinter, cotton, J. J. Faulkner 560,263
Seed from lint or fiber, machine for separating, W. Henderson 560,499
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Sewing machine, book, H. Brehmer 560,223
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Sewing machine shuttle, W. H. Barnett 560,292
Sewing machine stay guide, L. Levy 560,296
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Shafting hanger, B. Lobee 560,297
Shaving cabinet, F. A. Herrick 560,206
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Shoe form, S. F. Eaton 560,200
Sifter or chop grader, H. C. Draver 560,575
Signal. See Telephone signal. Train signal.
Signal transmitters, circuit for latent, F. B. Herzog 560,212
Signaling apparatus and system, electric, M. B. Leonard 560,619
Sinks, etc., support for, L. Nichols 560,302
Skirt, riding, H. Silverman 560,602
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Sliding gate, H. Grover 560,352
Slitting machine, J. D. Riggs 560,251
Smoke separator and conveyor, W. F. Kintner 560,219
Sodium chloride, treatment of, J. Meyrueis 560,518
Sole cutting machine, A. E. Lincoln 560,234
Spark arrester, M. E. Loehr 560,261
Spike, R. W. Beldleman 560 186
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Stand. See Camera stand.
Station indicator, A. W. Chormann 560,343
Steam and oil separator, S. J. McDonald 560,430
Steam engine, compound expansion, A. M. Haley 560,496
Steam generator, L. E. Solignac 560,286
Steam generator, drop tube, Curtis & Cunningham 560,307
Steam trap, W. Geipel 560,491
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Stitching machine, belt, T. A. Hagan 560,201
Stone lewis, J. Sherman 560,374
Stone, G. R. Moon 560,274
Stove, gas, L. Kahn 560,367
Stovepipe holder, D. R. Parks 560,532
Stove, portable cooking, A. S. Tomkins 560,445
Strap. See Car holding strap.
Stripping device, F. Deming 560,480
Suspenders and shoulder braces, combined, O. R. McCoy 560,276
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Swing, W. E. Clark 560,609
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Switchboard, D. M. Munro 560,275
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Table waiter, revolving, H. P. Richards 560,541
Telephone receiver, S. D. Field 560,403
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Thrasher, rotary, J. H. Koch 560,586
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Tire, pneumatic, H. C. Dean 560,196
Tire, pneumatic, Stern & Rothgiesser 560,376
Tire, pneumatic, H. J. Weldon 560,246
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Tires, puncture proof covering for pneumatic, C. W. Hazeltine 560,608
Tires, valve device for pneumatic, H. W. Adams, Jr 560,193
Tobacco cutting machine, N. Du Brul 560,575
Tool handle, York & Slaughter 560,457
Tug, thill, W. W. Gleckner 560,310
Turnstile, O. H. Williams 560,340
Typewriting machine, G. H. Davis 560,572, 560,573
Typewriting machine, H. H. Uns 560,244
Undershirt, A. G. Velasko 560,307
Valve, balanced piston, J. A. Smith 560,560
Valve, steam engine, S. F. Brousseau 560,467
Valves and valve seats, machine for repairing, F. E. Dexter 560,481
Vanillin, obtaining, W. Haarmann 560,494
Variable cut off engine, J. Abell 560,182
Vehicle runner, S. E. Oviatt 560,279
Vehicle screen, J. M. Fleming 560,203
Ventilating grease traps, system of, S. Vinot 560,335
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Water flowing into tanks, apparatus for reducing noise of, J. J. Spear 560,287
Water motor, A. R. Lewis 560,589
Water wheel, J. B. McCormick 560,301
Water wheel bucket, J. B. McCormick 560,300
Water wheel, turbine, C. A. Foreman 560,350
Weighing machine, F. H. Richards 560,543, 560,544, 560,545
Weighing machine feeding apparatus, F. H. Richards 560,544
Well filter casing, deep, G. W. Darbrow 560,399
Well strainer, driven, B. F. Smith 560,441
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Wheel, F. C. Hockensmith 560,584
Wheel chuck, R. B. Hain 560,554
Wheel fender and stop cover for vehicles, C. H. Stratton 560,331
Wheel scraper, vehicle, W. F. Smith 560,440
Whiffletree, Cason & Jamison 560,341
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Wire drawing machine, J. H. O'Donnell 560,278
Wire stripping tool, W. McMurtrie 560,524
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Carpet, C. F. Gedney 25,542
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Clasp, C. Miller 25,507
Collar, C. A. Ritter 25,509
Dish, C. E. Haviland 25,513
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Game board, M. Columbo 25,534
Glass dish, W. C. Anderson 25,512
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Plate, C. E. Haviland 25,515, 25,516
Sad iron cross bar, J. W. Brown, Jr 25,510
Spoon handle, Crees & Court 25,505
Spoons, etc., handle for, W. C. Codman 25,503, 25,504
Syringe, nasal, R. E. Conlin 25,510
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Tile, roofing, N. Spurgin 25,531
Type, font of printing, H. Nadall 25,524
Valve hand wheel, J. Giles 25,527
Vaporizer, J. S. Judge 25,509

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Ale and porter, J. Everard 28,268
Baking powder, Old Fort Spice and Extract Company 28,272
Beer, lager, Weger Brothers 28,267
Bicycles and parts thereof, Eastern Cycle Manufacturing Company 28,291
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Drying kilns, Emerson Company 28,282
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Heaters, steam and hot water, A. A. Griffing Iron Company 28,294
Heaters, steam and water, A. A. Griffing Iron Company 28,283, 28,293
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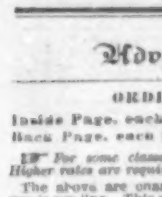

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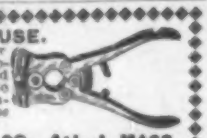
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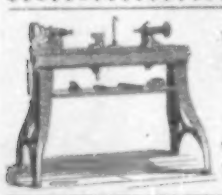

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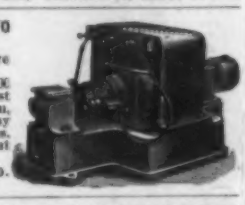
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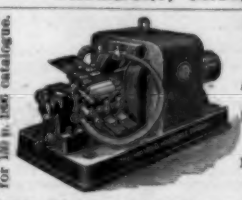
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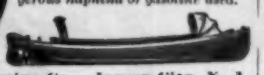

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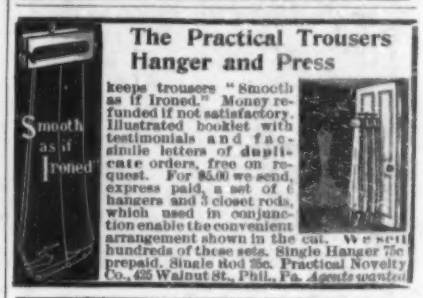

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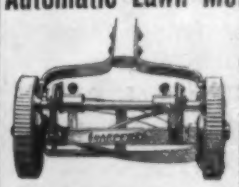

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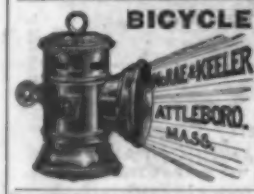

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